The Fleas (Siphonaptera) of Panama

VERNON J. TIPTON [1] AND EUSTORGIO MÉNDEZ [2]

Published records of fleas from Panama are fragmentary. Jennings (1910) surveyed the two terminal cities of Colon and Panama City for rats and fleas in an attempt to assess the plague potential resident within these two cities. Dunn (1923) listed the fleas known from the more common animals collected in and near the Canal Zone and admitted that his list was incomplete. He later (1934) listed additional species as a result of a general entomological investigation in Chiriquí Province and Fuller (1943) reported on still other material collected by Dunn. Collections made by Dunn in the vicinity of the Canal Zone and J. H. Batty in Chiriquí Province provided new material for taxonomic papers by Jordan and Rothschild (1922, 1923), Jordan (1926) and Kohls (1942). Fairchild (1943) brought together the existing records which included 12 common species and gave additional host data. Mendez and Altman (1960) described a new species of the genus *Kohlsia*. Tipton and Mendez (1961) described four new species and listed four species not previously known in Panama.

This study is based on material in our possession, for the most part collected by us. It attempts to provide data on host-parasite relationships and supplies keys and illustrations to facilitate the identification of the 37 species and subspecies of fleas known to occur in Panama. Six new species are described and seven species are recorded for the first time from Panama. In addition, the male of *Rhynchopsyllus megastigmata* Traub and Gammons, 1950, and the female of *Strepsylla dalmati* Traub and Barrera, 1955, are described.

We wish to express our appreciation to several people whose cooperation has made this study possible. We are especially grateful to Lt. Col. Robert M. Altman who initiated the field work on which much of this study is based. It was intended originally that he be a co-author of the publication resulting from our joint study. However, it has been impractical for us to continue the work as a joint project. Colonel Altman has been very cooperative and kindly allowed us to use material collected during his tour of duty in Panama. Colonel Robert Traub (Ret.), formerly with the United States Army Medical Research and Development Command, Office of the Surgeon General, and Mr. F. G. A. M. Smit, British Museum (Natural History), have compared many of our specimens with type material and have given helpful suggestions. We are grateful to Dr. Phyllis T. Johnson, Gorgas Memorial Laboratory, for her suggestions and permission to use illustrations contained in her outstanding study, *Fleas of South America.* Major Wallace P. Murdoch and Lt. Col. Gordon Field and their staff of illustrators at the 406th Medical General Laboratory in Tokyo prepared many of the figures contained herein and we are grateful for their cooperation and assistance. Charles M. Keenan has been most helpful with preparations for field trips as well as with collecting of host animals. Dr. Charles O. Handley has identified our host animals and has been very helpful in obtaining specimens, especially during a joint venture into the Chiriquí area during March, 1962. We wish also to acknowledge with gratitude the assistance rendered by field workers and laboratory technicians. Prodigious feats of strength and endurance in the field were equaled only by patience and painstaking care in the laboratory.

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[1] Lieutenant Colonel, Medical Service Corps, United States Army.

[2] Gorgas Memorial Laboratory, Panamá, Panamá.

KEY TO THE PANAMANIAN GENERA OF FLEAS[3]

1. Sword-like ridge of mesocoxa usually present, mesonotum with or without pseudosetae; metanotum much broader dorsally than ventrally 2
   Sword-like ridge of mesocoxa absent; metanotum lacking pseudosetae; metanotum rectangular, not especially broader dorsally than ventrally; never with more than one row of bristles on abdominal terga 3
2. With a combination of the following characters: anterior tentorial arm present, always inserting in front of eye; mesopleural rod not bifurcate dorsally; lacking head, thoracic and abdominal combs; ventral margin of pronotum never bilobed; fifth tarsal segment always with four lateral plantar bristles 10
   Not with above combination of characters 11
3. Inside of metacoxae with spiniform bristles; sensillium with 14 or more pits on a side; female with anal stylet 5
   Inside of metacoxae without spiniform bristles; sensillium with eight pits on a side; female without anal stylet 4
4. Anterior apical corner of hind coxa projecting downward as a broad tooth; no tooth at base of hind femur .... *Tunga* Jarocki
   Hind coxa without apical tooth; hind femur with a large basal tooth .... *Rhynchopsyllus* Haller
5. Thorax compressed; measured dorsally, meso- and metathorax together shorter than first abdominal tergum .... *Echidnophaga* Olliff
   Thorax normal; measured dorsally, meso- and metathorax together longer than first abdominal tergum 6
6. With both genal and pronotal combs .... *Ctenocephalides* Stiles and Collins
   With only pronotal comb or no combs 7
7. With pronotal comb .... *Hoplopsyllus* Baker
   Without pronotal comb 8

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[3] Partially adapted from Hopkins and Rothschild (1953) and Johnson (1957).

8. Dorsal sulcus above antennae absent or poorly sclerotized; mesopleural rod present; vestigial genal comb absent........................*Xenopsylla* Glinkiewicz
Dorsal sulcus above antennae well sclerotized; mesopleural rod absent; vestigial genal comb present..9

9. Frons smoothly rounded, without a tubercle.......................*Pulex* Linnaeus
Frons angulate, with small tubercle.........................*Juxtapulex* Wagner

10. Prosternosome projecting downward between the coxae; mesocoxa rectangular, margins parallel ....*Rhopalopsyllus* Baker
Prosternosome not projecting downward between coxae; mesocoxa not rectangular, obviously broadest basally...............................*Polygenis* Jordan

11. Head with helmet..*Plocopsylla* Jordan
Head without helmet...12

12. Pronotal comb present..13
Pronotal comb absent.......................................*Wenzella* Traub

13. Genal comb present; male with third aedeagal rod arising from aedeagal pouch....14
Genal comb absent; male with third aedeagal rod arising from ninth sternum......18

14. Genal comb of two spines...15
Genal comb of four spines................................*Adoratopsylla* Ewing

15. Genal comb of two overlapping spines (on rodents)...............*Strepsylla* Traub
Genal comb of two large spines which do not overlap (on bats)..................16

16. First abdominal tergum with well developed comb.............................17
First abdominal tergum without comb..........*Sternopsylla* Jordan and Rothschild

17. Metanotum and terga I through IV with combs...*Hormopsylla* Jordan and Rothschild
Only first abdominal tergum with comb...........*Ptilopsylla* Jordan and Rothschild

18. Pronotal comb with 24 or more spines..19
Pronotal comb with fewer than 24 spines.......................................20

19. Fifth segment of all tarsi with third pair of plantar bristles ventrally displaced...*Dasypsyllus* Baker
Fifth segment of all tarsi with third pair of plantar bristles not ventrally displaced ....*Ceratophyllus* Curtis

20. Males 21
Females 23

21. Distal arm of ninth sternum with stout, cephalad directed bristle; without apical or subapical spiniform bristles................................*Jellisonia* Traub
Distal arm of ninth sternum without stout cephalad directed bristle..............22

22. Distal arm of ninth sternum with distinct notch, lacking spiniform bristles...*Pleochaetis* Jordan
Distal arm of ninth sternum without notch, with spiniform bristles....*Kohlsia* Traub

23. Female anal stylet with dorsomarginal bristle..................*Pleochaetis* Jordan
Female anal stylet without dorsomarginal bristle...............................24

24. Tail of spermatheca almost twice length of head; head of spermatheca subglobular; bursa copulatrix lying in a horizontal plane.................*Kohlsia* Traub
Tail of spermatheca only slightly longer than head; head of spermatheca ovoid; bursa copulatrix lying in a vertical plane......................*Jellisonia* Traub

Superfamily PULICOIDEA

Family **Pulicidae**

Subfamily Pulicinae

Genus **Ctenocephalides** Stiles and Collins

Ctenocephalides Stiles and Collins, 1930, U.S. Publ. Hlth. Repts., Wash., 45: 1308.
Type-species: *Pulex canis* Curtis, 1826.

Ctenocephalides felis felis (Bouché). Plate 47.

Pulex felis Bouché, 1835, Nova Acta Leop.—Carol., 17: 505.
Ctenocephalides felis felis, Hopkins and Rothschild, 1953, Cat. Rothschild Coll. Fleas, 1: 145, figs. 14, 152, 155, 157, 161, 162; pls. 25E, 27A, B, D. Johnson, 1957, Mem. Ent. Soc. Wash., no. 5, p. 228, pls. 100, 101.

MATERIAL EXAMINED: 346 males and 742 females collected from several hosts including *Canis familiaris, Felis cattus, Didelphis marsupialis caucae, Nasua nasua narica, Eira barbara biologiae, Conepatus semistriatus trichurus, Liomys adspersus, Coendou mexicanus laenatus, Peromyscus nudipes nudipes, Felis onca centralis* and *Oryzomys caliginosus* from various localities throughout Panama. In addition, several hundred specimens in alcohol, from July 1956 to March 1962, collected by R. M. Altman, C. M. Keenan and V. J. Tipton.

REMARKS: Perhaps the most ubiquitous flea in Panama, *C. felis felis,* has been taken in all of our collecting localities and from a wide variety of hosts.

Ctenocephalides canis (Curtis)

Pulex canis Curtis, 1826, Brit. Ent., 3: 114, figs. A-E, 8.
Ctenocephalides canis, Johnson, 1957, Mem. Ent. Soc. Wash., no. 5, pp. 227–228.

MATERIAL EXAMINED: None.

REMARKS: We have not collected this species in Panama. However, Dunn (1923) reports a collection taken from a dog shortly after it had been brought to Panama from an island off the coast of Honduras.

Genus **Echidnophaga** Olliff

Echidnophaga Olliff, 1886, Proc. Linn. Soc. N. S. Wales, (2), 1: 171.
Type-species: *Echidnophaga ambulans* Olliff, 1886.

Echidnophaga gallinacea (Westwood). Plates 48 (fig. 2), 49 (figs. 3, 4).

Sarcopsylla gallinaceus Westwood, 1875, Ent. Month. Mag., 11: 246.
Echidnophaga gallinacea, Johnson, 1957, Mem. Ent. Soc. Wash., no. 5, p. 232, pls. 108, 109.

MATERIAL EXAMINED: None.

REMARKS: We have not collected this species although it is likely quite common throughout Panama. Dunn (1923) made several collections from such hosts as poultry, dogs, cats, rats, and man.

Genus **Pulex** Linnaeus

Pulex Linnaeus, 1758, Syst. Nat., 10th ed., 1: 614.
Type-species: *Pulex irritans* Linnaeus, 1758.

Pulex irritans Linnaeus

Pulex irritans Linnaeus, 1758, Syst. Nat., 10th ed., p. 614. Hopkins and Rothschild, 1953, Cat. Rothschild Coll. Fleas, 1: 105, figs. 3–6, 18A, 20B, 75, 124, 125; pls. 1, 4A, 21B, 22A–G. Smit, 1958, Jour. Parasit., 44, (5), pp. 523–526, fig. 2.

MATERIAL EXAMINED: 2 females from *Conepatus semistriatus trichurus,* Cerro Punta (Chiriquí), 12 March 1962, collected by C. O. Handley and V. J. Tipton.

REMARKS: *Pulex irritans* has been collected in Panama on a number of occasions but Hopla and Smit (personal communications, 1960) have indicated that these records are in error. Smit has kindly examined the Panamanian specimens labeled *P. irritans* in the British Museum. According to him, only one lot of 4 males and 4 females from Ancón are *P. simulans* Baker. An additional lot of 3 females from Bugaba is in alcohol and could be of either species. We have examined all specimens labeled as *irritans* in the United States National Museum and are of the opinion that they fit Smit's (loc. cit.) figures of *simulans*. There is one lot of 1 male and 4 females, which are regarded as *irritans*, but the origin of these specimens is doubtful, because they were removed from an airplane employed on the Balboa-New Orleans route.

We were unable to collect *P. irritans* in the Chiriquí area where Champion (Hopkins and Rothschild, 1953) found it at elevations from 4000 to 6000 feet, nor has it been found during several years of collecting in the Canal Zone. However, we have 2 females from skunk (*Conepatus semistriatus*) collected in Cerro Punta (Chiriquí) which are probably *irritans*.

Pulex simulans Baker. Plates 48 (fig. 4), 51 (figs. 6, 7).

Pulex simulans Baker, 1895, Can. Ent., 27: 65, 67. Smit, 1958, Jour. Parasit., 44, (5), pp. 523–526, fig. 1.

MATERIAL EXAMINED: 31 males and 53 females collected by Wilbur Lowe from man in Colón (Panamá), March, September and November, 1958. Also 1 male and 4 females from *Rattus norvegicus*, Panama City, May 1957, collected by E. Mendez.

REMARKS: Dunn (1923) reported a heavy infestation of *P. irritans* in a labor camp (Camp Maru) near the Chagres River on the Atlantic side of the Isthmus. Fuller (1942) lists one male collected from a dog in Panama City and Fairchild (1943) adds data on two lots from man at Moja Pollo, Chagres River area. We do not know whether these records refer to *P. irritans* or to the closely related species, *P. simulans*. We are not yet convinced that *simulans* is a distinct species but for the present we choose to retain it as valid, in view of the paucity of our material from hosts other than man. Assuming that the two species are morphologically distinguishable, we suggest that *simulans* occurs in the lowlands of Panama and that *irritans* is restricted to elevations of over 5000 feet.

Smit (loc. cit.) indicates that *irritans* has a predilection for man and large carnivores while *simulans* occurs on rodents which live in colonies. Our records do not bear this out since most of our specimens (31 males and 53 females) of *simulans* were collected from man and the remaining specimens (1 male and 4 females) were collected from *Rattus norvegicus*.

Genus **Juxtapulex** Wagner

Juxtapulex Wagner, 1933, Mitt. Berlin Zool. Mus., 18: 431.

Type-species: *Juxtapulex echidnophagoides* Wagner, 1933.

Juxtapulex echidnophagoides Wagner. Plates 48 (fig. 3), 49 (figs. 5, 6).

Juxtapulex echidnophagoides Wagner, 1933, Mitteil. Mus. Berlin, 18: 343, figs. 1A, 2–6. Hopkins and Rothschild, 1953, Cat. Rothschild Coll. Fleas, 1: 100–102, fig. 120. Tipton and Mendez, 1961, Ann. Ent. Soc. Amer., 54, (2), pp. 255–256.

MATERIAL EXAMINED: 273 males and 326 females from *Dasypus novemcinctus fenestratus;* 78 males and 138 females from *Didelphis marsupialis caucae;* 19 males and 19 females from *Felis onca concolor;* 1 male and 1 female from *Canis familiaris;* 1 male from *Sciurus granatensis chiriquensis;* 1 female from man. All, except *F. onca concolor* from El Volcán, were collected at Cerro Punta (Chiriquí) during July 1959, January and February 1960, January, April and May 1961, and March 1962, by C. O. Handley, C. M. Keenan, V. J. Tipton and C. E. Yunker.

REMARKS: Of 859 fleas of this species collected from 23 hosts, 599 (about 70 percent) were collected from 7 (34 percent) of the hosts, *Dasypus novemcinctus fenestratus,* at a rate of 85 fleas per host. Twelve specimens of *Didelphis marsupialis caucae* were collected at elevations above 5000 feet. From 11 of these, 216 fleas were removed at a rate of approximately 20 fleas per host. Even though *J. echidnophagoides* may live quite successfully in association with marsupials, it is likely that edentates are true hosts.

Genus **Hoplopsyllus** Baker

Hoplopsyllus Baker, 1905, Proc. U. S. Nat. Mus., **29**: 130.

Type-species: *Pulex anomalus* Baker, 1904.

Hoplopsyllus glacialis exoticus Jordan and Rothschild. Plates 50, 51 (figs. 1–5).

Hoplopsyllus exoticus Jordan and Rothschild, 1923a, Ectoparasites, 1: 311–312, fig. 314. Hopkins and Rothschild, 1953, Cat. Rothschild Coll. Fleas, 1: 192–193, fig. 181.

Hoplopsyllus glacialis exoticus, Tipton and Mendez, 1961, Ann. Ent. Soc. Amer., 54, (2), pp. 256–259, pls. 1, 2.

MATERIAL EXAMINED: 24 males and 47 females from *Sylvilagus brasiliensis gabbi,* 5 males and 3 females from *Didelphis marsupialis caucae,* 1 male from *Nasua nasua narica;* Cerro Punta (Chiriquí), January 1960, January 1961 and March 1962, collected by C. O. Handley, C. M. Keenan, V. J. Tipton and C. E. Yunker.

REMARKS: *H. glacialis exoticus* is found most commonly, although not exclusively, on rabbits. Apparently it does not occur on rabbits in the lowlands.

Genus **Xenopsylla** Glinkiewicz

Xenopsylla Glinkiewicz, 1907, Sitzber. Akad. Wiss. Wien, Abt. 1, **116**: 385.

Type-species: *Xenopsylla pachyuromyidis* Glinkiewicz, 1907.

Xenopsylla cheopis Rothschild. Plates 52, 53.

Pulex cheopis Rothschild, 1903, Ent. Month. Mag., (2), **14**: 85, pl. 1 (figs. 3, 9), 2 (figs. 12, 19).

Xenopsylla cheopis Hopkins and Rothschild, 1953, Cat. Rothschild Coll. Fleas 1: 248–260, figs. 20A, 76, 199, 220, 246, 255, 259, 266, 286, 305–308, 310, 391; pls. 2, 22D–F, 39A, 40E. Johnson, 1957, Mem. Ent. Soc. Wash., no. 5, pp. 226–227, pls. 98, 99.

MATERIAL EXAMINED: 3 males and 5 females *Rattus rattus;* Arraiján and Santa Fé; February and April 1959, collected by R. M. Altman and C. M. Keenan.

REMARKS: The distal arm of the ninth sternum is considerably more setose in our specimens than in those of Hopkins and Rothschild (1953). The shape of the spermatheca also differs but within the range of intraspecific variation.

Jennings (1910) collected 3022 fleas from 2394 rats (presumably of the genus *Rattus*), an average of 1.26 fleas per rat. Most of the fleas (2966 or 97.9 percent) were *X. cheopis.* In a later survey in Colón and Panama City in 1920–21, he collected 505 fleas from 1225 rats and mice. However, 1020 of the hosts were mice, from which only 29 fleas were removed. There were 476 fleas on 205 rats or an average of 2.33 fleas per rat. The rats captured on the drier Pacific side of the Isthmus were more heavily infested than those from the Atlantic side.

In recent years there have been very few specimens of *X. cheopis* collected in the Canal Zone. Only eight specimens of *X. cheopis* were collected from 119 rats in Arraiján just outside of the Canal Zone. The widespread use of insecticides for the control of mosquitoes may be partially responsible for the paucity of fleas on domestic rats.

Subfamily Tunginae

Genus **Tunga** Jarocki

Tunga Jarocki, 1838, Zoologiia, 6: 50.
Type-species: *Pulex penetrans* Linnaeus, 1758.

Tunga penetrans (Linnaeus). Plates 48 (fig. 1), 49 (figs. 1, 2).

Pulex penetrans Linnaeus, 1758, Syst. Nat., 10th ed., p. 614.
Tunga penetrans, Hopkins and Rothschild, 1953, Cat. Rothschild Coll. Fleas, 1: 39–43, figs. 21, 22A, 23, 26A, 28, 37; pls. 6A, B, 7A–C, 8B.

MATERIAL EXAMINED: 31 males and 9 females from *Sus scrofa;* Santa Fé (Veraguas) and Las Palmitas (Los Santos); January 1956, February 1957 and January 1962, collected by R. M. Altman, C. O. Handley and C. M. Keenan.

REMARKS: This species does not appear to be highly variable. Hopkins and Rothschild (loc. cit.) compare the claspers of males from Brazil and Nyasaland and as expected, our specimens agree more closely with those from Brazil. *T. penetrans* is widespread throughout Panama according to those who have visited villages of the interior. Residents of these villages are familiar with the "nigua," and in some areas of western Panama, it is a common pest of man and domestic pigs.

Genus **Rhynchopsyllus** Haller

Rhynchopsyllus Haller, 1880, Arch. Naturg., **46**, Bd. 1, p. 72.

Type-species: *Rhynchopsyllus pulex* Haller, 1880.

Rhynchopsyllus megastigmata Traub and Gammons. Plate 54.

Rhynchopsyllus megastigmata Traub and Gammons, 1950, Jour. Parasit., **36**, (3), pp. 271–272, figs. 6, 7.

MATERIAL EXAMINED: 4 males and 3 females from bat guano under tile on church at Pacora, 20 June 1961 and 12 January 1961; 1 female from *Tadarida yucatanica,* same locality, 20 June 1961; collected by C. M. Keenan and V. J. Tipton.

REMARKS: We are not certain that all of our specimens should be called *R. megastigmata.* Traub (personal communication, 1962) has pointed out that if the sexes are conspecific, there is extreme sexual dimorphism in this species. However, it seems unlikely that males of one species would be found occupying the same ecological niche as females of a closely related species. On the other hand, our series is small and it is possible that we have collected four male specimens of one species and three female specimens of another species in the same guano deposit. Perhaps at a later date, when male specimens of *R. pulex* have been collected, it will be possible to determine the extent of sexual dimorphism in this genus.

Our female specimens differ from the description and illustrations given by Traub and Gammons (loc. cit.) in several details. In our specimens, the spermatheca is extremely large, the abdominal spiracles are not quite as large, the lateral process of the prosternum and the maxillary lobe are longer and somewhat more acuminate, and the postoral process is broader basally. There also appear to be some differences in the arrangement of the bristles on the eighth tergum.

The type material, consisting of two females, and our four specimens make a total of six female specimens available for study. Such a short series does not allow a proper evaluation of intraspecific variation. Despite the possibility that our specimens may represent two distinct species, we choose to refer them to *R. megastigmata.*

DESCRIPTION, MALE: *Head* (pl. 54, fig. 1).—Dorsal margin of head shallow arc; anterior margin well rounded; ventral margin almost straight, terminating in small postoral process. One large preantennal bristle cephalad of eye; 10–11 minute spiniforms scattered over preantennal area. Eye well developed, subovate; with small ventral sinus. Genal process long, subacuminate. Maxillary lobe short, reaches to apex of first segment of maxillary palpus; broad basally, suddenly reduced to subacuminate apex. Stilettos broad, serrations not prominent; reach slightly beyond apex of maxillary palpus. Labial palpus three-segmented; reach almost to apex of forecoxa. Antenna oblong; bristles of second segment reach beyond middle of club. Postantennal area with four long bristles plus five or six spiniforms.

Thorax (pl. 54, fig. 2).—Pronotum with single row of four bristles. Prosternum broad, without lateral process. Mesonotum (*MSN.*) with row of five bristles. Mesosternum (*MST.*) undivided; with one long bristle. Metanotum (*MTN.*) with two or three bristles. Lateral metanotal area (*L.M.*) well developed. Metepisternum (*MTS.*) with long dorsal bristle immediately ventrad of prominent, strongly sclerotized pleural arch (*PL.A.*). Metasternum (*MTT.*) fairly well developed; saber-like. Metepimere (*MTM.*) large; with five bristles.

Legs.—Metafemur with basal spur. Tibia and first three tarsal segments much broader apically than basally. Third tarsal segment with two bristles which reach beyond apex of fifth segment.

Modified Abdominal Segments (pl. 54, figs. 3–5).—Eighth tergum (8*T.*) reduced. Tergum 9 with broad, cephalad-directed apodeme (*T. AP.* 9); rod-like dorsal apodeme. Manubrium much reduced, thumb-like; directed caudad. Immovable process of clasper (*P.*) large; with several small bristles scattered over surface. Movable process of clasper divided (F_1, F_2); apical half of F_1 broad, somewhat truncate; basal half with deep lateral sinus to accommodate ventral spur on F_2; caudal margin of F_2 strongly arched; anterior margin with truncate recess to receive apical portion of F_1. Distal arm of ninth sternum (*D.A.*9) roughly foot-like; with three small bristles on ventral margin, about 18 lateral bristles.

Aedeagus (pl. 54, fig. 6).—Aedeagal apodeme short, broad; with prominent middle plate (*MI.P.*) strongly hooked apically. Proximal spur absent. Crescent sclerite (*C.S.*) inconspicuous. Medial dorsal lobe (*M.D.L.*) rounded subapically; apex hook-like. Sclerotized inner tube (*S.I.T.*) long, straight; with prominent lateral process. Lateral lobe of adeagus (*L.L.*) broadly nipple-like. Crochet (*CR.*) broad basally; with short apical hook. Pseudocrochet (*PS.C.*) on broad stalk projecting from wall of aedeagal pouch; apex slightly rugose.

Superfamily RHOPALOPSYLLOIDEA
Family **Rhopalopsyllidae**
Subfamily Rhopalopsyllinae
Genus **Polygenis** Jordan

Polygenis Jordan, 1939, Novit. Zool. 41: 444.

Type-species: *Pulex roberti* Rothschild, 1905.

Polygenis atopus (Jordan and Rothschild). Plate 55.

Rhopalopsyllus atopus Jordan and Rothschild, 1922, Ectoparasites, 1: 267, figs. 259, 260.

Polygenis atopus, Johnson, 1957, Mem. Ent. Soc. Wash., no. 5, pp. 158–159.

MATERIAL EXAMINED: 2 males and 3 females from *Peromyscus nudipes nudipes* and 1 male from *Oryzomys albigularis,* Rancho Mojica (Bocas del Toro), September 1961, collected by V. J. Tipton.

REMARKS: In a comparison with the original description and figures we note that in our specimens the distal arm of the ninth sternum of the male is more setose and the apex not quite so truncate. The sinus in the process of the clasper is almost absent and P_1 is very short in our specimens.

As mentioned elsewhere, the flea fauna of *Peromyscus nudipes nudipes* captured on the Pacific slope was quite different from that of the Atlantic slope although the two localities were separated by only a few miles and at essentially the same elevation. *P. atopus* was not found on any of the more than 200 specimens of *P. nudipes nudipes* collected on the pacific slope but was found only on the Atlantic slope above 5000 feet elevation. The occurrence of *atopus* at this locality lends credence to the statement by Fairchild (personal communication, 1961) that it is not uncommon to find South American species of insects in Atlantic drainage localities on the Isthmus and that species of the Pacific drainage are characteristically North American.

Polygenis dunni (Jordan and Rothschild). Plates 56 (fig. 1), 57 (figs. 1, 2).

Rhopalopsyllus dunni Jordan and Rothschild, 1922, Ectoparasites, 1, (4), p. 269, figs. 261, 262. Jordan and Rothschild, 1923b, Ectoparasites, 1, (5), pp. 336, 351.

Rhopalopsyllus (*Polygenis*) *dunni*, Ewing and Fox, 1943, Fleas N. Am., p. 22.

Polygenis dunni, Costa Lima and Hathaway, 1946, Pulgas, p. 144.

Polygenis ambersoni Traub and Johnson, 1952, Bol. Of. Sanit. Panam., 32: 112, figs. 1–4, 6, 9, 10, 12–14, 16.

Polygenis dunni, Johnson, 1957, Mem. Ent. Soc. Wash., no. 5, pp. 160–161 (synonymizes *ambersoni*).

MATERIAL EXAMINED: 19 males and 19 females from *Liomys adspersus*, 2 males and 1 female from *Proechimys semispinosus panamensis*, 1 male and 1 female from *Zygodontomys microtinus*, 1 male from *Sigmodon hispidus chiriquensis*, 2 females from *Metachirus nudicaudatus dentaneus*, 1 female from *Oryzomys capito*, 1 female from *Sciurus granatensis chiriquensis;* Canal Zone, Cerro Azul, Río Seteganti, Chiriquí Lagoon; September–December 1956, July 1958, February 1960, January and March 1961, collected by R. M. Altman, C. M. Keenan, V. J. Tipton and C. E. Yunker.

REMARKS: Our specimens conform closely to the original description and show very little variation. However, we have a rather short series (23 males and 25 females).

Polygenis klagesi (Rothschild). Plates 56 (fig. 3), 57 (figs. 5, 5a, 6, 6a, 6b).

Pulex klagesi Rothschild, 1904, Novit. Zool., 11: 620, pls. 9 (fig. 28), 10 (figs. 35, 39).

Rhopalopsyllus klagesi samuelis Jordan and Rothschild, 1923b, Ectoparasites, 1: 331, figs. 342, 345.

Polygenis klagesi samuelis Johnson, 1957, Mem. Ent. Soc. Wash., no. 5: 164.

Rhopalopsyllus klagesi klagesi Jordan and Rothschild, loc. cit., p. 332, figs. 343, 344.

Polygenis klagesi klagesi Johnson, loc. cit., p. 163.

MATERIAL EXAMINED: 966 males and 1347 females from *Proechimys semispinosus panamensis*, 30 males and 51 females from *Hoplomys gymnurus*, 13 males and 18 females from *Tylomys panamensis*, 19 males and 24 females from *Nasua nasua narica*, 3 males and 8 females from *Zygodontomys microtinus*, 3 males and 7 females from *Didelphis marsupialis caucae*, 2 males and 2 females from *Oryzomys capito*, 2 females from *O. bombycinus*, 1 male and 3 females from *Dasyprocta punctata isthmica*, 2 males and 1 female from *Marmosa robinsoni*, 2 females from *Liomys adspersus*, 1 female from *Heteromys australis*, 1 female from *Sigmodon hispidus chiriquensis* and several hundred specimens in alcohol; from all collecting localities at 2500 feet elevation and below. In addition 8 males and 25 females from *Coendou mexicanus laenatus*, Cerro Punta (Chiriquí), collected by R. M. Altman, C. O. Handley, C. M. Keenan, V. J. Tipton, and Gorgas Memorial Laboratory.

REMARKS: Jordan and Rothschild (1923) referred Panamanian specimens of *P. klagesi* (Rothschild, 1904) to a new subspecies, *P. klagesi samuelis*, based on the shape of the spermatheca and the apical width of the movable process of the clasper compared with the immovable process of the clasper. It is our opinion that the figures and description given by Jordan and Rothschild are not adequate for an accurate assignment of our specimens to either subspecies. Furthermore, there is an unusual amount of variation in this species as expressed in the length of the distal arm of the ninth sternum. In specimens from the Canal Zone, the length of *D.A.*9 is 94 μ; from Cerro Azul, 140 μ; from Río Changena, 156 μ; and from Cerro Punta, 187 μ. The spermatheca of our specimens resembles the figure by Jordan and Rothschild for *P. klagesi klagesi,* while the male claspers more closely resemble their figures of *P. klagesi samuelis.* The width and length of the movable process of the clasper and the shape of the spermatheca are highly variable. Specimens from *Coendou mexicanus laenatus* (pl. 57, figs. 5a, 6a, 6b) collected in Chiriquí represent a distinct population and may be even a distinct species. Smit (personal communication, 1962) pointed out that the abdominal spiracles are larger and the seta below the eye is positioned differently than in *P. klagesi samuelis.* The shape of the spermatheca, the setal pattern of the clasper and the length of the distal arm differ from lowland specimens. It will be necessary to obtain specimens from the entire range of *P. klagesi* and a detailed study of the aedeagus will be required to determine the status of subspecific populations of this species.

Almost 99 percent of the fleas collected from *Proechimys semispinosus panamensis* were *Polygenis klagesi* and 51 percent of the specimens of *P. s. panamensis* harbored this flea. Over 92 percent of all the specimens of *klagesi* collected were from this host and 96 percent from hystricomorph rodents.

Records maintained over a period of four years indicate there is a seasonal fluctuation in the population of *P. klagesi.* It appears that the numbers increase at the onset of the wet season but drop off sharply as the rainfall increases. As will be noted in the table below, the dry season corresponds roughly with the first quarter of the calendar year. Rainfall is expressed as an average of both the Atlantic and Pacific sides of the Isthmus.

Quarter	*Average Rainfall per Month in Inches*	*Fleas per Rat (Positive Rats Only)*
1	1.7	2.8
2	7.3	14.4
3	10.7	4.0
4	11.7	1.7

Polygenis roberti beebei (I. Fox). Plates 56 (fig. 2), 57 (figs. 3, 4).

Rhopalopsyllus beebei I. Fox, 1947, Zoologica, 32: 117, fig. 2.
Polygenis roberti beebei, Johnson, 1957, Mem. Ent. Soc. Wash., no. 5, pp. 168–169.

MATERIAL EXAMINED: 13 males and 17 females from *Oryzomys capito,* 14 males and 29 females from *O. caliginosus chrysomelas,* 5 males and 5 females from *O. bombycinus,* 3 males and 7 females from *Didelphis marsupialis caucae,* 2 males and 4 females from *Nectomys alfari,* 2 males and 5 females from *Proechimys semispinosus panamensis,* 1 male and 2 females from *Philander opossum fuscogriseus,* 1 male and 2 females from *Zygodontomys microtinus,* 1 male from *Metachirus nudicaudatus dentaneus,* 3 females from *Marmosa robinsoni,* 1 female from *Peromyscus nudipes nudipes,* 1 female from *Heteromys desmarestianus;* all collecting localities between 2000 and 3000 feet elevation plus a few specimens from the Canal Zone; July–August 1956, May–June 1957, January–February 1958 and September 1961, collected by R. M. Altman, C. M. Keenan, V. J. Tipton, C. E. Yunker, and Gorgas Memorial Laboratory.

REMARKS: Most of our specimens were collected at 2550 to 3000 feet elevation. Although they are associated with a wide range of hosts they appear to have a predilection for oryzomine rodents.

KEY TO THE PANAMANIAN SPECIES OF *POLYGENIS* JORDAN

1. Immovable process of clasper (*P.*) divided by shallow sinus; spermatheca without sharp distinction between head and tail........*P. atopus* (Jordan and Rothschild)
   Immovable process of clasper (*P.*) not divided by sinus; spermatheca with sharp distinction between head and tail..2
2. Apex of movable process of clasper (*F.*) reaches to or beyond antero-dorsal margin of immovable process (*P.*); head of spermatheca roughly ovoid, tail narrow and not recurved back over head........................*P. klagesi* (Rothschild)
   Apex of movable process of clasper (*F.*) does not reach to antero-dorsal margin of immovable process (*P.*); head of spermatheca roughly triangular, tail broad and recurved back over head..3
3. Bristles of distal arm of ninth sternum short, approximately as long as width of distal arm of ninth sternum. Labial palpus does not reach trochanter I........ ....*P. roberti beebei* (I. Fox)
   Bristles of distal arm of ninth sternum long, approximately four times as long as width of distal arm; labial palpus reaches to trochanter I.................... ....*P. dunni* (Jordan and Rothschild)

Genus **Rhopalopsyllus** Baker

Rhopalopsyllus Baker, 1905, Proc. U. S. Nat. Mus., **29**: 128, 129, 143.

Type-species: *Pulex lutzi* Baker, 1904.

Rhopalopsyllus australis tupinus Jordan and Rothschild. Plates 58 (fig. 1), 59 (figs. 1, 2).

Pulex australis Rothschild, 1904, Novit. Zool., **11**: 613, pls. 9 (fig. 29), 10 (figs. 34, 36), partim.

Rhopalopsyllus australis tupinus Jordan and Rothschild, 1923b, Ectoparasites, **1**: 328, figs. 339. Johnson, 1957, Mem. Ent. Soc. Wash., no. 5, p. 176.

MATERIAL EXAMINED: 96 males and 130 females from *Dasyprocta punctata,* 24 males and 39 females from *Nasua nasua narica,* 2 males and 5 females from *Didelphis marsupialis caucae,* 3 males and 3 females from *Chironectes minimus,* 2 males and 2 females from *Tamandua tetradactyla,* 3 males and 11 females from *Proechimys semispinosus panamensis,* 8 males and 11 females from *Agouti paca virgatus,* 1 male and 1 female from *Zygodontomys microtinus,* 1 male from *Sciurus granatensis chiriquensis,* 1 female from *Philander opossum fuscogriseus,* 1 female from *Eira barbara biologiae,* 1 female from *Galictis allamandi,* 1 female from *Canis familiaris,* 1 female from man, 10 males and 20 females from *Tayassu tajacu;* mostly from Canal Zone but also from Chiriquí, Bocas del Toro, Los Santos, and Darién Provinces; November 1956 to March 1962, collected by R. M. Altman, C. O. Handley, C. M. Keenan, V. J. Tipton, C. E. Yunker, and Gorgas Memorial Laboratory.

REMARKS: Fuller (1942) lists *R. australis australis* from *D. marsupialis etensis*, Alhajuela; *R. australis tupinus* from *Tayassu tajacu*, Alhajuela; and *R. australis tamoyus* taken from *D. marsupialis etensis*, Ancón and Chilibrillo Caves. The morphological differences in these subspecies are based on the position of a notch of the movable process and a groove in the immovable clasper in relation to the acetabulum. With few exceptions our specimens fit the figures given by Jordan and Rothschild (1923) for *R. australis tupinus*. However, there is an unusual amount of variation in our series. For example, a male from *Dasyprocta punctata isthmica* is easily referrable to *R. australis tupinus* while another male from the same host specimen more closely approaches *R. a. tamoyus*. We prefer to refer all of our specimens to a single subspecies in view of the variation found in a series from a single host specimen. Further, it is very easy to confuse *R. lugubris* with subspecies of *R. australis;* this may have happened in the past.

The subspecies of *R. australis* are most frequently associated with agoutis, pacas and other hystricomorph rodents, and the carnivores which prey upon them. Most of our specimens were collected during the dry season but this may be due to the more favorable collecting conditions.

Rhopalopsyllus cacicus saevus Jordan and Rothschild. Plates 58 (fig. 3), 59 (figs. 5, 6).

Rhopalopsyllus cacicus saevus Jordan and Rothschild, 1923b, Ectoparasites, 1: 325, fig. 332. Johnson, 1957, Mem. Ent. Soc. Wash., no. 5, pp. 176–177.

MATERIAL EXAMINED: 77 males and 104 females from *Dasypus novemcinctus fenestratus,* 6 males and 12 females from *Didelphis marsupialis caucae,* 2 males and 3 females from *Proechimys semispinosus panamensis,* 5 females from *Philander opossum fuscogriseus,* 1 male and 1 female from *Nasua nasua narica,* 1 male from *Agouti paca virgatus,* 1 female from *Metachirus nudicaudatus dentaneus,* 2 females from *Dasyprocta punctata,* 105 males and 159 females from animal burrows (presumably *Dasypus novemcinctus fenestratus*) ; mostly from the Canal Zone, but a few from other sea level localities in Panama; July 1956 to March 1961, collected by R. M. Altman, C. M. Keenan and V. J. Tipton.

REMARKS: Fuller (1942) lists this species from *Dasypus novemcinctus* and *Didelphis marsupialis* from several localities in and near the Canal Zone. The variation due to orientation of specimens on microscope slides is frequently great enough to constitute what appear to be morphological differences. However, all of our specimens fit fairly closely the description and figures for *R. cacicus saevus.*

In many of the animal burrows listed above we found the host present. We have collected leaves and soil from the burrows in which we found *Dasypus novemcinctus fenestratus;* from this debris we have removed large numbers of *R. cacicus saevus.* We surmise that *D. novemcinctus fenestratus* is the true host of this flea at low elevations while *J. echidnophagoides* replaces *R. cacicus saevus* on the same host at high elevations.

Rhopalopsyllus lugubris cryptoctenes (Enderlein). Plate 59 (fig. 3a).

Rhopalopsyllus lugubris Jordan and Rothschild, 1908, Parasitology, 1: 74; pls. 3 (fig. 12), 6, (fig. 9).

Rothschildella cryptoctenes Enderlein, 1912, Zool. Anz., 40: 72, figs. 1–5, 7.

Rhopalopsyllus lugubris cryptoctenes, Johnson, 1957, Mem. Ent. Soc. Wash., no. 5, p. 177, pls. 92 (figs. 1–3, 5), 93 (figs. 1, 2, 5).

MATERIAL EXAMINED: 51 males and 64 females from *Agouti paca virgatus* and 17 males and 19 females from *Dasyprocta punctata isthmica;* El Volcán and Cerro Punta (Chiriquí); July 1958, June–July 1959, January 1960 and March 1962, collected by C. M. Keenan, V. J. Tipton, and Gorgas Memorial Laboratory.

REMARKS: All of our specimens of *R. lugubris* from paca and agouti in Chiriquí are *R. l. cryptoctenes.* Dunn (1934) reports this species from agoutis collected in the lowlands in Chiriquí Province but they were probably *R. l. lugubris.* Johnson (loc. cit.) lists a single male "ex human" collected by H. C. Mathes in Volcán (Chiriquí).

There is considerable variation in the characters used to separate *R. lugubris cryptoctenes* from the nominate subspecies. This is especially true of the incrassation which separates the lateral groove on the caudal margin of the process of the clasper from the acetabulum. In general, however, this incrassation is very broad in *cryptoctenes*, and it extends at least two-thirds of the distance from the acetabulum to the apex of the finger of the clasper. In the nominate subspecies the incrassation extends less than one-half this distance. The notch on the finger of the clasper opposite the lateral groove of the process of the clasper is subapical in *cryptoctenes* and is roughly at the midpoint in *lugubris.* There are no demonstrable differences in the females.

Rhopalopsyllus lugubris lugubris Jordan and Rothschild. Plates 58 (fig. 2), 59 (figs. 3, 4).

Rhopalopsyllus lugubris Jordan and Rothschild, 1908, Parasitology, 1: 74, pls. 3 (fig. 12), 6 (fig. 9).

Rhopalopsyllus lugubris lugubris, Johnson, 1957, Mem. Ent. Soc. Wash., no. 5, p. 177, pls. 92 (fig. 4), 93 (fig. 4).

MATERIAL EXAMINED: 15 males and 16 females from *Agouti paca virgatus,* 1 male and 3 females from *Dasyprocta punctata isthmica,* 7 males and 3 females from *Didelphis marsupialis caucae,* 1 female from *Zygodontomys microtinus,* 1 female from *Proechimys semispinosus panamensis* and 1 male and 2 females from man; Canal Zone, Darién, San Blas, Bocas del Toro Provinces and other sea level collecting localities; October 1957 through July 1958, April–October 1959, March, September 1961 and February 1962, collected by R. M. Altman, C. M. Keenan, V. J. Tipton, and Gorgas Memorial Laboratory.

REMARKS: All specimens of *R. lugubris* collected at elevations below 4000 feet are probably *R. l. lugubris.* In addition, 1 male and 1 female from man, Rancho Mojica (Bocas del Toro), elevation 5600 feet, have been assigned to this subspecies. None of our specimens of *R. lugubris* conform exactly to figures given by Jordan and Rothschild (1923b) or Johnson (loc. cit.) which makes clear the need for a revision of the genus *Rhopalopsyllus.*

Rhopalopsyllus species, near **mesus** Wagner

MATERIAL EXAMINED: 1 female from *Sciurus granatensis chiriquensis,* Cerro Punta (Chiriquí), January 1960, collected by C. M. Keenan and V. J. Tipton.

REMARKS: This single specimen has a rather unique spermatheca and probably represents an undescribed species. Its description, however, will await the collection of additional material.

KEY TO THE PANAMANIAN SPECIES OF *RHOPALOPSYLLUS* BAKER

1. Spiracle of metepimere oblong, prolonged dorsally; head of spermatheca globular. . ...*R. lugubris* (Rothschild)
Spiracle of metepimere rounded or subrounded; head of spermatheca not globular. . . .2
2. Labial palpus reaching to apex of coxa I or beyond; movable process of clasper longer than distal arm of ninth sternum; spermatheca not strongly S-shaped. . . . .*R. cacicus saevus* Jordan and Rothschild
Labial palpus not reaching apex of coxa I; movable process of clasper about as long as distal arm of ninth sternum; spermatheca strongly S-shaped.......... ....*R. australis tupinus* Jordan and Rothschild

Superfamily CERATOPHYLLOIDEA

Family **Ischnopsyllidae**

Genus **Hormopsylla** Jordan and Rothschild

Hormopsylla Jordan and Rothschild, 1921, Ectoparasites, 1, (3), p. 158.

Type-species: *Ceratopsylla fosteri* Rothschild, 1903.

Hormopsylla kyriophila, new species. Plates 60, 61.

DIAGNOSIS: *H. kyriophila* is more heavily sclerotized than the other species of the genus. In chaeotaxy of the frons and dorsal incrassations of the occiput it closely resembles *H. fosteri* (Rothschild). It may be separated from the latter species in that the male eighth sternum is subacuminate and bears about 16 regularly spaced bristles on the ventral margin to form a comb whereas in *fosteri* there are only eight to ten bristles and the apex is rounded; the distal arm of ninth sternum is not globular as in *fosteri;* the apical portion of the crochet is only slightly sinuate but is S-shaped in *fosteri* and the immovable process of the clasper is almost twice as wide as the movable process of the clasper while it is only slightly wider in *fosteri.* In the female the apex of the tail of the spermatheca almost touches the head of the spermatheca resulting in virtually a closed circle while the angle between the head and the tail of the spermatheca in *fosteri* is 30 to 40 degrees.

DESCRIPTION: *Head, Male* (pl. 60, fig. 1).—Anterior margin evenly rounded; preantennal area covered with 62–64 short, spiniform bristles plus four longer bristles; prominent mesal sclerotization running parallel with anterior margin of head; vertical incrassation extending from dorsal region. Two genal teeth; anterior tooth broad, about two-thirds length of narrower tooth; preoral tuber distinct. Genal process long, extends well beyond apex of antenna; apex rounded. Eye small, lightly pigmented. Postantennal area with five rows of marginal bristles of two bristles each; four vertical incrassations between rows of bristles, middle two most pronounced; diagonal row of bristles along antennal fossa; pale, mesal, triangular area with four short, three moderately long and three long bristles.

Thorax (pl. 60, fig. 2).—Pronotum with approximately nine bristles (three short, three moderately long, three long) ; about 24 teeth in pronotal comb which curves cephalad on ventral end. Mesonotum (*MSN.*) with six long bristles, four or five shorter bristles; two broad thickened areas extending ventrad from dorsal margin. Mesepimere (*MPM.*) with three long, six shorter bristles. Mesepisternum (*MPS.*) divided by broad horizontal band; two long, four shorter bristles above band; lower portion devoid of setae. Metanotum (*MTN.*) with four dorsal incrassations; seven long, two short bristles; apex with comb of ten teeth. Lateral metanotal area (*L.M.*) elongate, with single long bristle. Metepisternum (*MTS.*) with one long bristle; squamulum well developed. Metepimere (*MTM.*) with five bristles.

Legs.—Procoxa with about 36 bristles plus marginals; profemur with two short, one longer bristle on outer lateral surface. Meso-, metacoxae with heavily, sclerotized internal rods. Meso-, metafemora with single lateral bristle. Hind tibia with eight dorsocaudal notches with bristles arranged 2-2-1-2-2-1-2-2; single bristles between last five notches. Tarsal segment lengths (in μ) 156, 140, 104, 68, 125; four pairs lateral plantar bristles.

Abdomen.—Terga 1–4 with well developed combs with teeth numbering 18, 14, 14, 14; each tergum with globular sclerotization extending from dorsal margin; two bristles per segment with bases near dorsal margin plus two additional bristles more ventrad with spiracle between them. Minute bristle at base of single, long antesensillial bristle. Sterna with darkened, heavily sclerotized areas near ventral margins; one bristle per sternum.

Modified Abdominal Segments, Male (plate 61, figures 4, 5, 6, and 7).—Tergum 8 (8*T.*) with four stout bristles caudad of sensillium; caudal margin rounded. Sternum 8 (8*S.*) with broad, subacuminate process bearing 15–16 small bristles on ventral margin resembling comb. Distal arm of ninth sternum (*D.A.* 9) with pronounced lobe on caudoventral margin bearing one short, one long setae; apex shaped like head of bird with prominent cephalad-directed beak; small marginal seta proximad of throat; two longer setae on back of neck. Immovable process of clasper (*P.*) membranous; outline indistinct; apex reaches to approximately midpoint on movable process of clasper (*F.*). *F.* prominent; with five or six lateral bristles distad of *P.*; point of articulation with *P.* medial.

Aedeagus (pl. 60, fig. 3).—Aedeagal apodeme (*AE.A.*) long, slender; with upturned, acuminate apex; proximal spur (*P.S.*) prominent; apex angular. Accessory lateral lobe (*A.L.L.*) with prominent dorsal hump. Crescent sclerite (*C.S.*) small, rod-like. Median dorsal lobe (*M.D.L.*) a membranous flap with distal half doubled. Lateral lobes (*L.L.*) with caudal margin subtruncate. Crochet (*CR.*) very broad basally; apex slightly sinuous, acuminate.

Modified Abdominal Segments, Female (pl. 61, figs. 1–3).—Seventh sternum (7*S.*) with sloping, almost straight caudal margin; bearing six or seven lateroventral bristles. Eighth tergum (8*T.*) with two long, lateral bristles plus several marginals. Eighth sternum (8*S.*) indistinct, broadly rounded caudal margin. Dorsal anal lobe of proctiger with five or six bristles. Anal stylet about twice as long as wide; long apical bristle plus minute subapical bristle. Ventral anal lobe of proctiger with shallow sinus in caudal margin; with two long submarginal, four or five marginal bristles. Spermatheca swollen slightly on head-end, otherwise little distinction between head and tail; curved so that apex of tail almost touches head. Bursa copulatrix club-shaped; with slightly sinuous handle.

TYPE MATERIAL: Holotype male (host no. 7583) from *Tadarida yucatanica,* collected under roof tile on belfry of church at Pacora, about 25 miles northeast of Panama City (Panamá), elevation sea level, 21 June 1961, collected by C. M. Keenan and V. J. Tipton. Allotype female (host no. 7284), same locality and collectors, 20 June 1961. Paratypes: 2 males and 9 females, same host, locality, and collectors, 6 June 1961 (host no. 7231), 20 June 1961 (host nos. 7291, 7504, 7509), 21 June 1961 (host nos. 7563, 7566, 7589); 3 females, same locality and collectors, from *Molossus coibensis* (host nos. 7297, 7501), 20 June 1961; 11 males and 6 females, same locality and collectors, from bat guano (coll. no. 8824) 12 January 1962.

Holotype male and allotype female in the collection of the United States National Museum. Paratypes (1 pair each) deposited in the British Museum (Natural History); Chicago Natural History Museum; Gorgas Memorial Laboratory in Panama City; Environmental Health Branch, Corozal, Canal Zone; private collections of Robert Traub and the senior author.

Genus **Ptilopsylla** Jordan and Rothschild

Ptilopsylla Jordan and Rothschild, 1921, Ectoparasites, 1, (3), p. 158.

Type-species: *Ptilopsylla leptina* Jordan and Rothschild, 1921.

Ptilopsylla dunni Kohls. Plates 62, 63. Figure 34.

Ptilopsylla dunni Kohls, 1942, Jour. Parasit., 28, (5), pp. 361–362, 1 fig. Hopkins and Rothschild, 1956, Cat. Rothschild Coll. Fleas, 2: 207–208, figs. 301, 335, 357, 358, pls. 19A, 23A, 25A. Johnson, 1957, Mem. Ent. Soc. Wash., no. 5, pls. 44–46.

MATERIAL EXAMINED: 83 males and 163 females from *Tadarida yucatanica*, 66 males and 129 females from *Molossus coibensis* and 2667 males and 5305 females from bat guano. Bats were collected in mist nets, or, like bat guano, were collected from under roof tile on the belfry of the church at Pacora about 25 miles northeast of Panama City (Panamá), elevation sea level, by C. M. Keenan, C. E. Yunker and V. J. Tipton in June and July of 1961 and January of 1962.

REMARKS: *P. dunni* is represented by a series of several thousand specimens. They conform quite well to the figures given by Johnson (1957) except for the crochet. We have a few specimens with crochets like those in Johnson's drawings but the majority of them are oriented so that the crochet resembles an inverted high-heeled boot or a raised thumb and pointing index finger with a membrane between (pl. 63, figs. 2, 3). In some of our male specimens, the length of *P* is greater than in specimens shown by Johnson, and the spicules on the base of the eighth sternum are shorter and more numerous. There is some variation in the shape of *F*, especially in the dorsocaudal margin. There is no apparent difference in specimens taken from hosts and reared specimens taken from bat guano.

P. dunni is extremely rare in collections and we had been unable to obtain it during two years of intensive collecting. There were no fleas on hundreds of specimens of *M. coibensis* collected in various localities throughout Panama. This may indicate that *T. yucatanica* is the true host and *M. coibensis* was infested only because of close association with *T. yucatanica*.

We can only speculate about the length of time the bat colony has inhabited the Pacora church where we obtained the hosts and guano. Bat guano was six inches deep in places when Bloedel (1955) observed the colony in 1953. Residents of the town claim that the church is very old. This is substantiated by a 1785 date inscribed on a silver incense burner which was made in Mexico especially for the church. However, it is reported that the church was rebuilt in 1941 or 1942.

The estimated 1000 specimens of *Tadarida yucatanica* observed by Bloedel were said to constitute the major portion of the bat population. There were also small colonies of *Myotis nigricans nigricans* and *Noctilio labialis minor*. Bloedel observed no immatures or pregnant females.

In June and July of 1961 when we made our collections, small numbers of *Molossops p. planirostris* and *Noctilio l. labialis* and several hundred *Tadarida yucatanica* were living under the tile on the roof of the belfry of the church. Bloedel had observed the latter two species hanging from the floor joists in the attic. We observed many immature specimens of *T. yucatanica*. We also captured many specimens of *Molossus coibensis*, a few *Glossophaga soricina leachii*, and one *Phyllostomus hastatus panamensis* in a mist net near the church. We presume they came from the attic of the church where we had observed bats earlier.

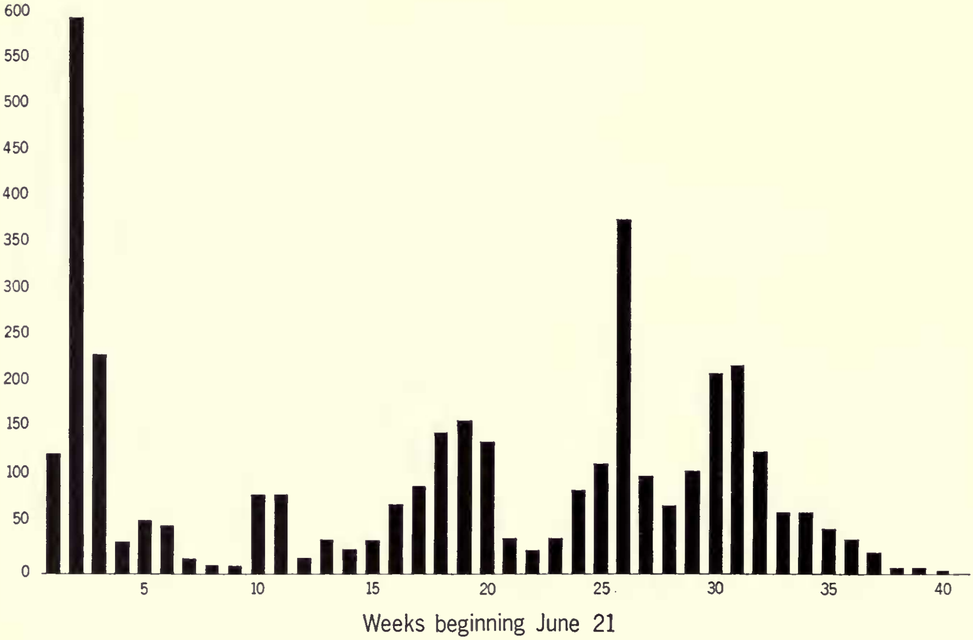

Fig. 34. Numbers of *Ptilopsylla dunni* which emerged from bat guano over a 40 week period (see text).

Bat guano was abundant under the tile on the belfry of the church and we removed approximately 45 pounds during the June collecting trip and an additional 32 pounds on a subsequent trip in July. Guano was divided into three-pound lots and placed in paper bag containers. The tops of the bags were fastened with paper clips. As the adult fleas emerged they moved to the surface of the guano and jumped on the sides of the paper bags. The bags were examined daily or every other day and the fleas were removed with applicator sticks, the tips of which had been dipped in 70 percent alcohol. As the guano began to dry out, wet paper towels were added to each bag after the adult fleas had been removed.

At first, it appeared that this was a pure colony of *Ptilopsylla dunni* Kohls and during the first month over 3000 specimens were removed from the guano. Eventually three male specimens of *Rhynchopsyllus megastigmata* Traub and Gammons emerged. The latter species was somewhat smaller and moved more sluggishly, so perhaps other specimens were present but were not observed earlier in the collecting. By late April 1962, it appeared that the guano would produce no more specimens. Over the 9-month period, 3634 adult fleas had emerged continuously from the 45-pound batch of guano. This suggests that development is arrested by unfavorable conditions or that some mechanism insures survival of the species during times when the host species is absent from the roosting place. After a small amount of guano had been sterilized in an autoclave, 16 adult fleas of both sexes were introduced into this material. Although it was examined at frequent intervals during the subsequent two months, no adult fleas were recovered.

Additional bat guano was collected during the dry season (January 1962) and adult fleas (*P. dunni*) emerged at about the same rate as from the wet season material. This was also apparently true for *Hormopsylla kyriophila* and *R. megastigmata.*

Figure 34 shows the number of fleas (*P. dunni* only) removed from the bat guano collected in June. The erratic emergence rate may be due to humidity variations. Wet paper towels were not added to the paper bags until after the first month when the guano had begun to dry out.

Genus **Sternopsylla** Jordan and Rothschild

Sternopsylla Jordan and Rothschild, 1921, Ectoparasites, 1, (3), p. 158.

Type-species: *Ischnopsyllus texanus* C. Fox, 1914.

Sternopsylla distincta speciosa Johnson. Plates 64, 65.

Sternopsylla distincta speciosa Johnson, 1957, Mem. Ent. Soc. Wash., no. 5, p. 100, pls. 48 (figs. 3, 4), 50 (figs. 3, 8).

MATERIAL EXAMINED: 11 males and 12 females from *Myotis nigricans nigricans,* 1 male and 3 females from mixed collection of *M. nigricans nigricans* and *M. chiloensis,* 2 males and 1 female from *Tadarida brasiliensis,* 1 male and 1 female from *Tadarida yucatanica,* 313 males and 250 females from bat guano from cave where both species of *Myotis* and *T. brasiliensis* were roosting; all from Cerro Punta (Chiriquí) except specimens from *Tadarida yucatanica* from Rancho Mojica (Bocas del Toro); April, May and September 1961 and March 1962, collected by C. M. Keenan, V. J. Tipton and C. E. Yunker.

REMARKS: Johnson (1957) indicates there is some variation in the shape of the crochet of *S. distincta distincta.* Some variation in this character is found in *S. distincta speciosa* too. Compared with her figures, the bases of the crochets of our specimens tend to be broader and to taper less abruptly. Our material agrees closely with her figures of the eighth and ninth sterna and the clasper. However, in the female, she shows the bursa copulatrix straight and lying in a vertical plane (*S. d. distincta*), whereas in our specimens only the apical portion lies in a vertical plane and there is an abrupt bend.

Species of the genus *Sternopsylla* are most frequently found on molossid bats and various species of *Myotis*. The cave from which our host bats were collected was inhabited by *Tadarida brasiliensis*, *Myotis nigricans nigricans* and *Myotis chiloensis*. We have not collected specimens of *S. d. speciosa* below 5000 feet elevation.

Family **Ceratophyllidae**

Genus **Ceratophyllus** Curtis

Ceratophyllus Curtis, 1832, British Ent., 9: pl. 417, text.
Type-species: *Ceratophyllus hirundinis* Curtis, 1832.

Ceratophyllus altus, new species. Plate 66.

DIAGNOSIS: *C. altus* is near *C. idius* Jordan and Rothschild but may be distinguished from that species as follows: the membranous apical flap of the eighth sternum has a narrow, saber-like, horizontal lobe without a fringe, while in *idius* this lobe is broad and fringed at the base; the vertical lobe of the apical flap of the eighth sternum is fringed in both species but the pseudosetae are more prominent in *altus* (pl. 66, fig. 7); the movable process of the clasper extends beyond the apex of the immovable process of the clasper for about one-half its length in *altus* but much less than one-fourth its length in *idius*.

DESCRIPTION, MALE: *Head* (pl. 66, fig. 1).—Frontoclypeal margin rounded; with moderately well developed frontal tubercle; presetal area pitted; with two rows of three bristles each. Eye ovate, well pigmented. Genal process subacuminate. Maxillary lobe extends to distal end of penultimate segment of maxillary palpus. Apical setae of second antennal segment about one-half length of club. Postantennal area with row of fine bristles on margin of antennal fossa; two long bristles; posterior row of five or six bristles interspersed with fine setae.

Thorax (pl. 66, fig. 2).—Pronotum with five or six long bristles interspersed with fine setae; pronotal comb of 28–29 spines. Mesonotum (*MSN.*) with three rows of bristles arranged 5-5-5. Mesepisternum (*MPS.*) with two small medial bristles plus one minute seta near caudal margin. Mesepimere (*MPM.*) with three long bristles. Metanotum (*MTN.*) with two rows of bristles arranged 5-3; intercalary setae between bases of bristles of second row. Lateral metanotal area (*L.M.*) with one long bristle. Metepisternum (*MTS.*) with single long bristle. Metepimere (*MTM.*) with three long bristles.

Legs.—Procoxa with 24–25 bristles on lateral surface. Meso-metacoxae with strongly sclerotized internal rods; several long bristles in distal angle. Profemur with two bristles on outer surface plus five or six bristles on inner surface. Meso-metafemora with single bristle on outer surface; four or six bristles on inner surface. Metatibia with about 13–15 medial bristles on outer surface. Length of metatarsal segments 270.4, 156, 104, 62.4, 124.8 μ. No tarsal bristles reach beyond apex of next segment. Fifth tarsal segment of all legs covered with microsetae.

Abdomen.—Apical spinelets on terga 1–4 paired; single on terga 5, 6. Terga with two rows bristles of about five bristles per row with intercalary microsetae between bases of second row. Basal sternum with submarginal bristles; sterna 3–7 with row of three stout bristles. Single antesensillial bristle between two minute bristles.

Modified Abdominal Segments (pl. 66, figs. 3–7).—Tergum 8 large, membranous flap, almost entirely covering genitalia; with four stout bristles on dorsal margin. Eighth sternum triangular basally; punctate; becoming long, moderately narrow apically, with three apical bristles; six marginal bristles; sword-like apical flap bearing caudally directed spiculose membranous process. Immovable process of clasper (*P.*) with broadly rounded apex bearing three short bristles; two long acetabular bristles midway on caudal margin between apex and base. Movable finger of clasper (*F.*) ham-like; broad medially, tapering somewhat to broadly rounded apex; extending for almost one-half its length beyond apex of *P.*; with one long apical bristle surrounded by three or four smaller bristles; three additional bristles on caudal margin. Proximal arm of ninth sternum curved caudad subapically. Distal arm of ninth sternum very narrow basally, abruptly swollen into proximal lobe bearing 17–18 marginal or submarginal bristles; narrower distal lobe resting on proximal lobe bears 12–15 marginal to submarginal bristles; apex rounded, with 15–18 small setae scattered on medial surface plus three or four larger marginal setae.

Aedeagus (pl. 66, fig. 4).—Aedeagal apodeme long, narrow; with long coiled apical appendage; neck short. Lateral lobe (*L.L.*) narrow, inapparent; median dorsal lobe (*M.D.L.*) bifid, open apically. Crochet (*CR.*) swollen ventrally; apex subacuminate, beak-shaped.

TYPE MATERIAL: Holotype male (host no. 7477) from *Glaucidium jardinii,* about five miles beyond Cerro Punta on the Boquete Trail (Chiriquí), elevation 7800 feet, 3 May 1961, collected by C. E. Yunker and C. M. Keenan. Deposited in the collection of the United States National Museum.

Genus **Dasypsyllus** Baker

Dasypsyllus Baker, 1905, Proc. U. S. Nat. Mus., 29: 129.

Type-species: *Ceratophyllus perpinnatus* Baker, 1904.

Dasypsyllus gallinulae perpinnatus (Baker). Plate 67.

Ceratopsyllus gallinulae Dale, 1878, Hist. Glanville's Woot., pp. 291, 292.
Ceratophyllus gallinulae, Rothschild, 1903, Ent. Month. Mag., (2), 14: 145, 146.
Dasypsyllus gallinulae, Wagner, 1927, Konowia, 7: 104, 106, figs. 2, 4B.
Ceratophyllus perpinnatus Baker, 1904, Proc. U. S. Nat. Mus., 27: 386, 391, 445, figs. 1–6.
Dasypsyllus perpinnatus, Baker, 1905, loc. cit., 29: 129, 146.
Ceratophyllus gallinulae perpinnatus, Jordan, 1926, Novit. Zool., 33: 386.
Dasypsyllus gallinulae perpinnatus, Wagner, 1930, Kat. Siphonap., p. 14.

MATERIAL EXAMINED: 2 males and 6 females from *Sciurus granatensis chiriquensis,* 5 males and 7 females from nest of *Zonotrichia capensis costaricensis,* 3 males and 7 females from nest of *Vireo leucophrys chiriquensis;* near Cerro Punta (Chiriquí), January and May 1960, April 1961 and March 1962, collected by C. L. Hayward, C. M. Keenan, V. J. Tipton, and C. E. Yunker.

REMARKS: We have examined many birds and bird nests for fleas but have found this species only at high elevations. It is probably much more common than our records would indicate since we have concentrated on mammal collecting in the Chiriquí mountains.

Dasypsyllus lasius venezuelensis (I. Fox and Anduze). Plates 68, 69.

Ceratophyllus lasius Rothschild, 1909, Novit. Zool., **16**: 63, fig. 10.

Dasypsyllus lasius, Jordan, 1933, Novit. Zool., **39**: 76.

Avesopsylla venezuelensis I. Fox and Anduze, 1947, Bol. Ent. Venez., **6**: 108, pl. 1, figs. 1–3.

Dasypsyllus lasius venezuelensis, Johnson, 1957, Mem. Ent. Soc. Wash., no. 5, p. 117, pls. 53–55.

MATERIAL EXAMINED: 193 males and 242 females from nests of *Notiochelidon cyanoleuca,* 1 male and 5 females from nest of unknown host which contained both bird and rodent fleas and ticks, 1 female from *N. cyanoleuca;* near Cerro Punta (Chiriquí), March 1962, collected by C. L. Hayward and V. J. Tipton.

REMARKS: This species was very abundant in swallow nests, both in buildings as well as earth banks. In one hole in an earth bank the fleas were very numerous in the sand below the scanty nesting material.

Genus **Jellisonia** Traub

Jellisonia Traub, 1944, Field Mus. Nat. Hist., Zool. Ser., **29**: 211.

Type-species: *Jellisonia klotsi* Traub, 1944.

Jellisonia johnsonae Tipton and Mendez. Plates 70, 71.

Jellisonia johnsonae Tipton and Mendez, 1961, Ann. Ent. Soc. Amer., 54, (2), pp. 259–262, pls. 3, 4.

MATERIAL EXAMINED: 14 males and 27 females from *Scotinomys teguina,* 4 males from *S. xerampelinus,* 6 males and 3 females from *Peromyscus nudipes nudipes,* 3 males and 10 females from *Reithrodontomys sumichrasti vulcanius,* 1 male from *R. creper,* 1 female from *R. mexicanus garichensis,* 1 female from *Bassaricyon gabbii gabbii,* and 5 males and 5 females from nest; near Cerro Punta (Chiriquí), January, February and May 1960, January and April 1961, March 1962, collected by C. O. Handley, C. M. Keenan, V. J. Tipton, and C. E. Yunker.

REMARKS: Specimens collected subsequent to the type material do not vary greatly from the original figures and description. Some two years after the type material was obtained, about 500 small animals were collected in the same general area but at a little higher elevation. There was a decided paucity of *J. johnsonae* on this group of hosts. There is much to be learned about host preferences and seasonal and altitudinal distribution of fleas in this area.

Jellisonia species

One female from *Reithrodontomys mexicanus,* Rancho Mojica (Bocas del Toro), collected by V. J. Tipton, 10 September 1961, may be *J. johnsonae* but the dorsal lobe of the female seventh sternum is more pronounced. Another female from *Oryzomys capito,* Cerro Hoya (Los Santos), collected by C. O. Handley, 12 February 1962, is quite distinct and undoubtedly represents an undescribed species. The dorsal lobe of the female seventh sternum is pronounced and the ventral margin is concave.

Genus **Pleochaetis Jordan**

Pleochaetis Jordan, 1933, Novit. Zool., 39: 77.

Type-species: *Ceratophyllus mundus* Jordan and Rothschild, 1922.

Pleochaetis altmani Tipton and Mendez. Plates 72, 73.

Pleochaetis altmani Tipton and Mendez, 1960, Ann. Ent. Soc. Amer., 54, (2), pp. 262–263, pls. 5, 6.

MATERIAL EXAMINED: A total of 58 males and 58 females as follows: 28 males and 29 females from *Reithrodontomys creper,* 2 males from *R. sumichrasti vulcanius,* 4 males and 1 female from *R. mexicanus garichensis,* 16 males and 12 females from *Scotinomys xerampelinus,* 5 males and 12 females from *Peromyscus nudipes nudipes,* 2 males and 2 females from *Oryzomys fulvescens vegetus,* 1 male and 2 females from *O. albigularis* near Cerro Punta (Chiriquí), collected by C. M. Keenan, V. J. Tipton, and C. E. Yunker, between January 1960 and March 1962.

REMARKS: In addition to the type material collected in 1960, an additional lot of 6 males and 7 females was collected in May of 1961 and a long series of 49 males and 50 females was collected in March of 1962. We have a relatively long series of specimens of this species and it is remarkable for its lack of variation. In some male specimens the dorsal margin of the crochet is straighter than in the type material and the dorsal and apical margins are slightly serrate. The outline of the female seventh sternum is quite constant.

Pleochaetis dolens dolens (Jordan and Rothschild). Plates 74, 75.

Ceratophyllus dolens Jordan and Rothschild, 1914, Novit. Zool., 21: 257, figs. 1, 2.

Pleochaetis dolens, Jordan, 1923, Novit. Zool., 29: 27.

Pleochaetis dolens dolens, Traub, 1950, Fieldiana, Zool. Mem., 1: 34–36, pls. 18, 19. Tipton and Mendez, 1961, Ann. Ent. Soc. Amer., 54, (2), pp. 263–264.

MATERIAL EXAMINED: A total of 194 males and 285 females as follows: 104 males and 140 females from *Sciurus granatensis chiriquensis,* 47 males and 58 females from *Peromyscus nudipes nudipes,* 8 males and 6 females from *Reithrodontomys sumichrasti vulcanius,* 4 males and 8 females from *R. mexicanus garichensis,* 2 males and 4 females from *R. creper,* 4 males and 5 females from *Scotinomys xerampelinus,* 1 male and 3 females from *S. teguina,* 1 male and 6 females from *Oryzomys fulvescens vegetus,* 1 male and 3 females from *O. alfaroi alfaroi,* 3 females from *O. albigularis,* 3 females from *Nyctomys sumichrasti,* 1 male from *Mus musculus,* 1 male from *Heteromys desmarestianus,* 4 males and 8 females from *Didelphis marsupialis caucae,* 5 males and 9 females from *Bassaricyon gabbii gabbii,* 1 female from *Procyon lotor,* 1 female from *Nasua nasua,* 1 female from *Mustela frenata,* 11 males and 23 females from nests; all collected near Cerro Punta (Chiriquí) and Rancho Mojica (Bocas del Toro) by C. M. Keenan, V. J. Tipton, and C. E. Yunker, from January 1960 to March 1962.

REMARKS: This is a highly variable species but the aedeagal structures, especially the crochet, are rather constant. Fifty-one per cent of all the specimens of *P. dolens dolens* collected in Panama have been taken from *Sciurus* *granatensis chiriquensis* and 22 per cent have been collected from *Peromyscus nudipes nudipes.* The table below indicates the distribution of this flea on *Sciurus granatensis* according to elevation:

Elevation	*Specimens of Sciurus granatensis*	*Total P. dolens dolens*	*Number of P. dolens dolens per host*
Below 4000 ft.	63	0	0
4000–5000 ft.	2	0	0
5000–6000 ft.	10	18	2
Over 6000 ft.	48	227	5

There may be some seasonal variation in the number of fleas per host since there were eight specimens of *P. dolens dolens* per host collected during the latter part of April and early part of May at elevations in excess of 6000 feet.

Genus **Kohlsia** Traub

Kohlsia Traub, 1950, Fieldiana, Zool. Mem., 1: 45.

Type-species: *Kohlsia osgoodi* Traub, 1950.

Kohlsia azuerensis, new species. Plates 76, 77.

DIAGNOSIS: *K. azuerensis* n. sp. resembles *K. uniseta* Traub (1950) and *K. graphis graphis* (Rothschild). It is easily distinguished from *uniseta* in possessing two acetabular bristles. It may be separated from *graphis graphis* in that there is a single, long, apical bristle on the reduced male eighth sternum and the distal arm of the ninth sternum is broader and more setose. In addition, the caudal margin of the female seventh sternum has a deep sinus not present in the other two species.

DESCRIPTION: *Head, Male* (pl. 76, fig. 1).—Small frontal tubercle on broadly rounded anterior margin of head; micropunctate preantennal area with large ovate pores cephalad of 15–16 bristles. Eye subovate, not heavily pigmented. Ovate trabecula centralis. Apex of genal process subrounded. Maxillary lobe reaches slightly beyond distal end of second segment of five-segmented labial palpus. Maxillary palpus four-segmented. Postantennal area with about 11–13 bristles arranged in three rows.

Thorax (pl. 76, fig. 2).—Pronotal comb of about 18 spines caudad of row of five or six bristles. Mesonotum (*MSN.*) with row of three thin bristles, row of five or six slightly longer bristles, then row of three or four long bristles; about six microsetae on flange; two or three subapical pseudosetae. Mesepisternum (*MPS.*) with patch of four small, thin setae in cephalodorsal angle plus two or three bristles in caudoventral area. Mesepimere (*MPM.*) with five bristles; does not cover lateral metanotal area. Metanotum (*MTN.*) with six or seven bristles arranged in two irregular rows. Lateral metanotal area (*L.M.*) broader than long; with two long bristles. Metepisternum (*MTS.*) with single long bristle. Pleural arch well defined. Metepimere (*MTM.*) with six or seven long bristles.

Legs.—Coxae and femora not unusual. Metatibia with nine dorsomarginal notches bearing bristles arranged 2-2-1-2-2-1-1-2-3. Last segment of metatarsus with six pairs plantar bristles with sixth pair medially displaced.

Abdomen.—Terga 1–4 with apical spinelets; paired on terga 2–3; two rows of bristles on all terga ranging from three to five bristles per row. Bristles on sterna 2–7 arranged 1-3(4)-3-3(4)-3-3. Dorsal antesensillial bristle about three times longer than ventral bristle.

Modified Abdominal Segments, Male (pl. 77).—Tergum 8 indistinct but appears to cover most of genitalia. Sternum 8 with short, thin process bearing long apical bristle plus short, thin, subapical bristle. Distal arm of ninth sternum broad, with well sclerotized rod reaching almost to apex; ventral lobe bearing 11–12 marginal or submarginal bristles; patch of 11 medial bristles which becomes diagonal row of additional nine or ten bristles terminating in two subapical spiniform bristles; small apical bristle plus three more small bristles on dorsal margin; apex not produced caudad into lobe. Immovable process of clasper (*P.*) with slightly concave caudal margin bearing two long acetabular bristles near base. Movable process of clasper (*F.*) reaches apex of *P.;* caudal margin bears three heavy marginal bristles plus two or three small marginal bristles; several medial microsetae.

Aedeagus (pl. 77, fig. 1).—Aedeagal apodeme more than twice as long as aedeagus proper; prominent proximal spur (*P.S.*) arising near base of blade-like accessory lateral lobe (*A.L.L.*) Median dorsal lobe (*M.D.L.*) with smoothly rounded anterior margin; convoluted to form handle-like paradorsal lobe (*P.D.L.*); primary medial dorsal lobe (*P.M.D.*) with flared, hyaline apex. Lateral lobes (*L.L.*) well developed; ventral margin bulbous. Crochet (*CR.*) well developed but lightly sclerotized; triangular, with apex, dorsal and caudoventral margins tufted. Sclerotized inner tube (*S.I.T.*) rod-like, heavily sclerotized; with prominent, lateral, "seed-cluster" sclerite. Subacuminate, curved caudal process (*A.M.S.*) arising mesad of hooked anterior process of armature of inner tube (*A.I.T.*). Crescent sclerite (*C.S.*) prominent. Penis rods strongly recurved but not coiled.

Modified Abdominal Segments, Female (pl. 76, figs. 3–5).—Caudal margin of seventh sternum (7*S.*) with acuminate dorsal lobe followed by deep sinus; ventral lobe broadly rounded; with medial row of six bristles. Eighth tergum (8*T.*) with nine or ten long, three or four short medial bristles plus three or four marginals. Eighth sternum (8*S.*) not clearly defined. Anal stylet more than twice as long as broad. Head of spermatheca subglobular; tail more than twice as long as head; bent at right angle to head. Bursa copulatrix lying in diagonal plane with cephalad end inflated; bent slightly to lie in horizontal plane.

TYPE MATERIAL: Holotype male (host no. 9955) from *Peromyscus* species near *P. pirrensis,* about ten airline miles west of Las Palmitas (Los Santos), elevation 3000 feet, 20 February 1962, collected by C. O. Handley. Allotype female (host no. 9934) same data as above except 17 February 1962. Paratypes: 3 males and 2 females, same data as holotype; 1 female, same data as allotype; 2 females (host no. 9855), same data as holotype but 11 February 1962; 1 male and 1 female (host no. 9915), same data as holotype but 15 February 1962; 1 male (host no. 10040), same data as holotype but 26 February 1962. Holotype and allotype deposited in the United States National Museum; 1 pair of paratypes deposited with each of the following named institutions and individuals: British Museum (Natural History), Chicago Natural History Museum, Gorgas Memorial Laboratory, and private collections of Robert Traub and the senior author.

Kohlsia graphis graphis (Rothschild). Plate 78.

Ceratophyllus graphis Rothschild, 1909, Novit, Zool., 16: 62, pl. 10, figs. 3, 4.
Kohlsia graphis graphis, Traub, 1950, Fieldiana, Zool. Mem., 1: 50–51, pls. 29 (fig. 6), 30 (figs. 5–7). Tipton and Mendez, 1961, Ann. Ent. Soc. Amer., 54, (2), pp. 272.

MATERIAL EXAMINED: 5 males and 11 females from *Sciurus granatensis chiriquensis,* near Cerro Punta (Chiriquí), collected by C. M. Keenan, V. J. Tipton, and C. E. Yunker from January 1960 to March 1962.

REMARKS: Our specimens differ slightly from Traub's (1950) figures. In our males the distal arm of the ninth sternum is more setose and the dorsal margin distad of the sharp angle is shorter. The proximal hump on the latero-ventral, curved lobe of the apodemal strut of the aedeagus is similar to that figured for *K. g. erana* Traub but the apex is like *K. g. graphis* (Rothschild). The caudal margin of the seventh sternum of the female has a nipple-like bump suggesting a dorsal lobe and the ventral portion of the margin is concave while Traub shows this margin to be straight. The spermatheca also has some slight differences such as the concavity in the ventral margin of the head.

Our failure to collect a longer series of this species is probably related to season and altitude. A total of 60 specimens of *Sciurus granatensis chiriquensis* was collected from localities that are above 5000 feet and fleas were removed from 47 of the specimens. All of the 60 specimens were collected during the dry season or the early part of the wet season and none were collected above 7000 feet elevation. The majority of our specimens of *K. g. graphis* were collected late in the dry season or early wet season. Nests from which squirrel ticks and *Pleochaetis d. dolens* were collected contained no specimens of *K. g. graphis.*

Kohlsia keenani Tipton and Mendez. Plates 79, 80.

Kohlsia keenani Tipton and Mendez, 1961, Ann. Ent. Soc. Amer., 54, (2), pp. 265–269, pls. 7, 8.

MATERIAL EXAMINED: A total of 5 males and 13 females as follows: 2 males and 3 females from *Peromyscus nudipes nudipes,* 2 males and 4 females from *Oryzomys fulvescens vegetus,* 1 male and 1 female from *O. albigularis,* 2 females from *O. alfaroi alfaroi,* 2 females from *Scotinomys xerampelinus,* 1 female from *S. teguina,* all collected by C. M. Keenan, V. J. Tipton, and C. E. Yunker near Cerro Punta (Chiriquí), January 1960 to March 1962.

REMARKS: The majority of the specimens (three males and eight females) were collected during the first collecting trip in May, 1960. Although hundreds of small rodents were collected during subsequent trips in a much wider variety of ecological situations, only two additional males and five females were obtained. All specimens conform closely to figures given.

Kohlsia mojica, new species. Plates 81, 82.

DIAGNOSIS: *Kohlsia mojica* n. sp. is very close to *K. traubi* Tipton and Mendez in size, shape and setation of the processes of the clasper; in the general structure of the aedeagus; in the outline of the seventh sternum and shape of the spermatheca of the female. *K. mojica* differs from *traubi* in that the distal arm of ninth sternum of the male is bilobed, somewhat as in *keenani* Tipton and Mendez, while there is a single ventral lobe in *traubi;* the caudal process of eighth sternum of the male is much broader and while the crochet is roughly conical as in *traubi,* the top of the cone is rectangular and the bottom portion of the cone is contiguous with the proximal corner of the rectangle.

DESCRIPTION: *Head, Male* (pl. 81, fig. 1).—Anterior margin of head broadly rounded;

with small but distinct frontal tubercle; preantennal area micropunctate; three irregular rows of bristles arranged 8(9)-5-3 with intercalary setae; eye subovate; lightly pigmented. Genal process subrounded. Maxillary lobe reaches almost to midpoint of distal segment of four-segmented maxillary palpus. Labial palpus five-segmented; reaches to about two-thirds length of forecoxa. Postantennal area with three rows bristles arranged 3(4)-5(6)-5(6). Microsetae along margin of antennal fossa. Pedicel of antenna without long bristles. Trabecula centralis prominent, ovate.

Thorax (pl. 81, fig. 2).—Pronotum with row of five (six) bristles; intercalary setae between bases of bristles; about 20–21 spines in pronotal comb. Mesonotum (*MSN.*) with small scattered setae on anterior portion followed by medial, irregular row of six or seven bristles, then row of four stout bristles with intercalary setae; two pseudosetae on flange. Mesepisternum (*MPS.*) with two to four stout bristles plus one to three fine medial setae; anterodorsal area with three to four fine setae. Mesepimere (*MPM.*) with about eight stout bristles. Metanotum (*MTN.*) with three rows bristles arranged 2(3)-6(5)-4; first row incomplete, second row irregular, third row with intercalary setae. Lateral metanotal area (*L.M.*) broader than long; with two stout bristles. Metepisternum (*MTS.*) with one long stout bristle. Squamulum well developed. Pleural arch well defined. Metepimere (*MTM.*) with five to seven bristles.

Legs.—Procoxa with about 35–38 bristles exclusive of marginals. Outer surface of profemur with six to eight thin setae; mesal surface with single seta. Protibia with seven dorso-caudal notches bearing bristles arranged (base to apex) 1-2-2-2-1-2-3; plus five to six medial bristles. Fifth tarsal segment on all legs longest; fourth segment shortest; six pairs plantar bristles, basal and distal pairs displaced medially. Internal rods of meso- and metacoxae strongly sclerotized. Meso-, metatibiae with eight dorso-caudal notches bearing bristles arranged (base to apex) 1-2-1-2-2-1-2-3; with 10–13 medial bristles.

Abdomen.—Terga 1–4 with apical spinelets; sometimes paired on terga 1–3. Tergum 1 with three rows bristles arranged 2-6-5 with some variation; terga 2–7 with two rows of bristles usually arranged 6–7 but may vary from 3–7 in first row and 5–7 in second row. Basal sternum with one seta; sterna 3–7 each with one row of three bristles, occasionally four bristles per row. One long antesensillial bristle between two short bristles; ventral bristle less than one-third length of middle bristle and three times longer than dorsal bristle.

Modified Abdominal Segments, Male (pls. 81, figs. 3–5; 82, figs. 4, 5).—Tergum 8 indistinct but caudal margin lies in close proximity to caudal margin of immovable process of clasper; with two long and three shorter bristles in dorsocaudal area. Sternum 8 with well developed process; highly variable in shape, number and position of bristles; usually broad, with two to three apical bristles plus three to five medial bristles. Distal arm of ninth sternum with well sclerotized mesal rod running from base almost to apex; bilobed, with well rounded ventral lobe bearing three or four stout marginal bristles plus seven or eight small medial setae; apical lobe bearing three marginal spiniform bristles plus five or six medial setae; cephalodorsal margin broadly rounded, bearing single thin bristle. Immovable process (*P.*) of clasper reticulate; apex short, subrounded, bearing three small bristles; caudal margin almost straight, with two long acetabular bristles. Movable finger of clasper (*F.*) equal to *P.* in length; apex subacuminate; caudal margin evenly rounded, bearing small subapical bristle, three stout marginal bristles plus three short, thin, submarginal bristles.

Aedaegus (pl. 82, fig. 4).—Aedeagal apodeme about three times longer than aedeagus proper; proximal spur (*P.S.*) prominent, ribbon-like; accessory spur of aedeagus (*A.S.P.*) small, seta-like, arising from base of slightly sinuous, acuminate accessory lateral lobe (*A.L.L.*). Crescent sclerite (*C.S.*) distinct. Median dorsal lobe (*M.D.L.*) inflated apically to form blade-like primary median dorsal lobe (*P.M.D.*); primary paradorsal lobe (*P.D.L.*) buttonhook-like. Lateral lobe of aedeagus (*L.L.*) with truncate apex lying near primary median dorsal lobe; with angular caudal margin. Crochet (*CR.*) roughly cone shaped but with beak-like and nipple-like projections on distal margin. Penis rods strongly recurved but not coiled.

Modified Abdominal Segments, Female (pl. 82, figs. 1–3).—Caudal margin of seventh sternum (7*S*.) with conspicuous sinus; dorsal lobe short, subrounded; margin ventrad of sinus almost straight; with medial row of four or five bristles per side. Eighth tergum (8*T*.) with about six or seven small bristles cephalodorsad of spiracle; approximately six long plus five shorter medial bristles; four or five caudomarginal bristles. Eighth sternum (8*S*.) poorly defined. Ninth sternum (9*S*.) inapparent. Dorsal anal lobe of proctiger with nine or ten marginal bristles plus eight medial bristles. Anal stylet about twice as long as wide; long apical bristle less than twice length of ventral bristle; dorsomarginal and medial microsetae. Ventral anal lobe with eight or nine marginal and four medial bristles. Head of spermatheca subglobular; tail almost twice as long as head, bent at right angles to head. Bursa copulatrix sinuate, cephalad end dilated.

REMARKS: This species is named for the type locality, Rancho Mojica (Bocas del Toro), comprised of two thatched huts and a few coffee trees but offering a welcome respite from two days on a mountainous jungle trail.

TYPE MATERIAL: Holotype male (host no. 8129) and allotype female (host no. 8136) from *Peromyscus nudipes nudipes,* Rancho Mojica, about 30 miles west of Almirante near the Río Changena (Bocas del Toro), elevation 5500 feet, 13 September 1961, collected by V. J. Tipton. Paratypes: 17 males and 15 females all from (15) *Peromyscus nudipes nudipes* with same data as above except collected from 8 thru 13 September 1961. Holotype and allotype deposited in the United States National Museum; one pair of paratypes in each of: the British Museum (Natural History), Chicago Natural History Museum, Gorgas Memorial Laboratory, private collections of Robert Traub, and the senior author.

Kohlsia tiptoni Mendez and Altman. Plates 83, 84.

Kohlsia tiptoni Mendez and Altman, 1960, Proc. Ent. Soc. Wash., 62, (1), pp. 45–50, figs. 1–11.

MATERIAL EXAMINED: 1 female from *Sciurus granatensis chiriquensis,* 1 female from nest, near Cerro Punta (Chiriquí); May 1961 and March 1962, collected by C. L. Hayward, C. M. Keenan, V. J. Tipton, and C. E. Yunker

REMARKS: Very little information can be added to that given by Mendez and Altman (1960). We have collected only 2 female specimens since the type material was collected.

Kohlsia traubi Tipton and Mendez. Plates 85, 86.

Kohlsia traubi Tipton and Mendez, 1961, Ann. Ent. Soc. Amer., 54, (2), pp. 269–272, pls. 9, 10.

MATERIAL EXAMINED: 180 males and 177 females from *Peromyscus nudipes nudipes,* 1 male and 1 female from *Oryzomys alfaroi alfaroi,* 1 female from *O. fulvescens vegetus,* 3 females from *Sciurus granatensis chiriquensis,* 1 male from *Reithrodontomys creper,* 1 male from *Heteromys desmarestianus,* 3 females from nests, 1 female from workbench used for preparation of animal skins; all collected by C. M. Keenan, V. J. Tipton, and C. E. Yunker near Cerro Punta (Chiriquí), January 1960 to March 1962.

REMARKS: There is some variation in this species, but the taxonomic characters of significance are fairly constant, i.e., the shape of the crochet, the median dorsal lobe, the distal arm of the ninth sternum and the claspers. The shape and setation of the caudal process of the eighth sternum varies considerably (pl. 85, figs. 5, a, b) as does the caudal margin of the female seventh sternum.

Of a total of 365 specimens collected, almost 98 per cent (357) were from *P. nudipes nudipes.* No specimens were collected below 5000 feet and they appeared to be evenly distributed from 5000 feet to 8000 feet.

KEY TO THE PANAMANIAN SPECIES OF *KOHLSIA* TRAUB

1. Movable finger of clasper with four stout bristles on caudal margin; legs with tibial combs .... *K. tiptoni* Mendez and Altman
   Movable finger of clasper with three stout bristles on caudal margin; legs without tibial combs 2
2. Length of setae on proximal lobe of distal arm of ninth sternum greater than width of proximal lobe; female with combination of following characters: length of head of spermatheca not greater than one-half length of tail; seventh sternum with no deep sinus on caudal margin and not more than four bristles .... *K. traubi* Tipton and Mendez
   Length of setae on proximal lobe of distal arm of ninth sternum less than width of proximal lobe; female without above combination of characters 3
3. Distal arm of ninth sternum bilobed; caudal process of eighth sternum with more than four bristles per side; female seventh sternum with fewer than five bristles per side 4
   Distal arm of ninth sternum not bilobed (apex not bent caudad to form apical lobe); caudal process of eighth sternum with fewer than four bristles per side; female seventh sternum with more than five bristles per side 5
4. Median dorsal lobe of aedeagus with beak-like process; distal arm of ninth sternum with only one or two bristles between proximal and apical lobes; caudal margin of female seventh sternum with dorsal lobe subtruncate .... *K. keenani* Tipton and Mendez
   Median dorsal lobe of aedeagus smoothly rounded, without beak-like process; distal arm of ninth sternum with at least five or six bristles between proximal and apical lobes; caudal margin of female seventh sternum with dorsal lobe subacuminate .... *K. mojica* n. sp.
5. Caudal process of male eighth sternum with single apical bristle; distal arm of ninth sternum with more than 36 bristles; crochet with tufted caudal process; caudal margin of female seventh sternum with pronounced sinus . . *K. azuerensis* n. sp.
   Caudal process of male eighth sternum with two or three apical or subapical bristles; distal arm of ninth sternum with fewer than 36 bristles; crochet with fang-like caudal process; caudal margin of female seventh sternum straight or only slightly concave .... *K. graphis graphis* (Rothschild)

Comments on the Genus *Kohlsia* Traub

There are now 18 described species and subspecies of the genus *Kohlsia* Traub of which four species are known only from Panama. *K. graphis graphis* (Rothschild) is known from both Panama and Nicaragua and *K. tiptoni* Mendez and Altman is known from Panama and Costa Rica. There are some peculiarities in the geographical distribution of the Panama species. In the mountains of western Panama within a radius of ten miles there are three distinct species of *Kohlsia* which occur on the same host species, *Peromyscus nudipes nudipes.* In the same area *K. graphis graphis* occurs on squirrels. Just over 150 airline miles to the southeast another species, *K. mojica* n. sp., is associated with *Peromyscus flavidus*. *K. tiptoni* is represented in our collections by only a few specimens so we are unable to establish true host relationships for this species. In the mountains of eastern Panama there are other *Peromyscus, Sciurus* and *Microsciurus* species and undoubtedly additional undescribed species of *Kohlsia*. Such a rich fauna seems unusual for a relatively small geographical area, though Panama is remarkable in its great ecological variety.

Climatic factors probably influence the distribution of fleas to a much greater extent than that of the hosts. Of the three species of *Kohlsia* on *P. n. nudipes* in western Panama one (*mojica*) was collected on the humid Atlantic slope and the other two on the drier Pacific slope. One of the latter two species, *traubi*, was very abundant and the other species, *keenani*, quite rare (total of 18 specimens). It may be either a nest species or the true host is unknown.

We suggest another possibility to account for the distribution of *Kohlsia* species in Panama. It seems unlikely that this flea genus and its host genera have evolved concurrently. It may be that some of the true hosts no longer occur in this area and certain of the present hosts have been "adopted."

Family **Hystrichopsyllidae**

Subfamily Ctenophthalminae

Genus **Adoratopsylla** Ewing

Adoratopsylla Ewing, 1925, Jour. Parasit., 12: 44.
Type-species: *Adoratopsylla bisetosa* Ewing, 1925.

Adoratopsylla intermedia copha (Jordan). Plates 87, 88.

Stenopsylla intermedia copha Jordan, 1926, Novit. Zool., 33: 391, fig. 15.
Adoratopsylla intermedia copha, Ewing and Fox, 1943, Fleas N. Am., p. 82.
Tritopsylla intermedia copha, Costa Lima and Hathaway, 1946, Pulgas, p. 228. Jordan, 1950, Bull. Wld. Hlth. Org., 2: 605.
Adoratopsylla (*Tritopsylla*) *intermedia copha*, Johnson, 1957, Mem. Ent. Soc. Wash., no. 5, p. 33, pls. 15, 16 (of *A. intermedia* ssp.).

MATERIAL EXAMINED: 138 males and 185 females from *Didelphis marsupialis caucae*, 199 males and 190 females from *Metachirus nudicaudatus dentaneus*, 25 males and 16 females from *Philander opossum fuscogriseus*, 3 males and 3 females from *Marmosa robinsoni*, 1 female from *Oryzomys caliginosus* and 1 female from *Proechimys semispinosus panamensis;* El Valle, Cerro Azul, Cerro Campana, Cerro Hoya and Cerro Punta; July 1956 to February 1962, collected by R. M. Altman, C. O. Handley, C. M. Keenan, V. J. Tipton, and Gorgas Memorial Laboratory.

REMARKS: The host animals on which *A. intermedia* ssp. occurs are large and are capable of harboring large populations of fleas. As many as 152 specimens have been collected from a single host animal. The host genera, *Philander, Marmosa, Metachirus* and especially *Didelphis,* are both widespread and numerous in Central America. They occur from sea level to elevations in excess of 5000 feet. Because the hosts are ubiquitous, their geographical range is large, and they are capable of harboring large numbers of fleas, it follows that there must be a tremendous population of this species of flea in South and Central America. A wide range of variation is thus expected.

In a series of 60 males and 92 females collected from a single host animal, *Didelphis marsupialis caucae* from Cerro Punta (Chiriquí), elevation 5300 feet, there is some variation in the outline of the female seventh sternum and in the shape of the movable clasper of the male. However, all of these specimens plus 225 additional males and 224 females collected west of the Canal Zone are readily identified as *Adoratopsylla intermedia copha.* An additional lot of 77 males and 77 females collected at Cerro Azul and Cerro Jefe (east of the Canal Zone) are much more variable and may represent a distinct subspecific population. A detailed study is necessary to properly evaluate the intra-specific populations according to hosts and geographical distribution.

Subfamily Neopsyllinae

Genus **Strepsylla** Traub

Strepsylla Traub, 1950, Fieldiana, Zool. Mem., 1: 75.
Type-species: *Strepsylla mina* Traub, 1950.

Strepsylla dalmati Traub and Barrera. Plate 89.

Strepsylla dalmati Traub and Barrera, 1955, Fieldiana Zool., 37: 541–544, pls. 10 (figs. 1–3), 13 (fig. 1). Tipton and Mendez, 1961, Ann. Ent. Soc. Amer., 54, (2), p. 272.

MATERIAL EXAMINED: A total of 10 males and 20 females as follows: 5 males and 9 females from *Peromyscus nudipes nudipes,* 2 males and 3 females from *Reithrodontomys creper,* 1 male from *R. sumichrasti vulcanius,* 1 male and 3 females from *Scotinomys xerampelinus,* 1 male and 3 females from *Sciurus granatensis chiriquensis* and 1 female from *Oryzomys fulvescens vegetus;* near Cerro Punta and on the Boquete Trail (Chiriquí); January and May 1960, April and May 1961 and March 1962, collected by C. O. Handley, C. M. Keenan, V. J. Tipton and C. E. Yunker.

REMARKS: For the most part our male specimens are in agreement with figures and description given by Traub and Barrera (1955). Differences in the shape of the distal arm of the ninth sternum may be more apparent than real, since the shape of the membranous portion is easily distorted in mounting. The entire caudal margin of the eighth sternum is convex in our specimens whereas there is a slight concavity shown in the original figure. Both the eighth and ninth sterna as well as the movable process of the clasper are slightly more setose in our specimens than in *S. dalmati, s. str.*

We withstood the temptation to describe the female in an earlier publication (1961) because of the possibility of having two distinct species represented in our relatively short series. Now, with a much longer series, we are quite confident that our 20 female specimens represent the undescribed female of *S. dalmati.*

DESCRIPTION: *Modified Abdominal Segments, Female* (pl. 87, figs. 5–7).—Caudalmost portion of seventh sternum (7*S.*) strongly convex followed by shallow concavity; row of four or five long bristles preceded by seven to nine smaller bristles. Eighth tergum (*8T.*) with row of five bristles over spiracle; second row of five bristles cephaloventrad of first; four or five thin bristles caudad of antesensillial bristles. Angular margin of eighth tergum ventral to ventral anal lobe, with five stout bristles; medial area with seven stout laterad-directed bristles plus eight or nine smaller caudad-directed bristles. Eighth sternum (*8S.*) with subacuminate apex bearing three small dorsomarginal bristles, seven thin lateral bristles plus one long bristle on ventro-caudal angle. Anal stylet more than four times as long as wide; long apical bristle flanked by two minute subapical bristles. Ventral anal lobe angulate, strongly sclerotized; with six or seven strong marginal bristles plus two or three medial bristles. Spermatheca subovate; head almost twice as wide as tail; head deeply invaginated by dorsal margin of tail; tail strongly recurved back over head. Bursa copulatrix lying in horizontal plane for most of its length; slightly sinuate.

Subfamily Rhadinopsyllinae

Genus **Wenzella** Traub

Wenzella Traub, 1953, Jour. Wash. Acad. Sci., 43: 77.

Type-species: *Wenzella obscura* Traub, 1953.

Wenzella yunkeri, new species. Plates 90, 91.

DIAGNOSIS: *Wenzella yunkeri* n. sp. can be easily distinguished from the type-species, *Wenzella obscura* Traub. In the latter species, the movable process of the clasper is narrow and extends beyond the apex of the immovable process of the clasper for almost one-half of its length, while in *yunkeri* it is broad and only slightly longer than the immovable process. The eighth sternum of *yunkeri* does not have the broadly rounded caudal margin as does *obscura* and it is more setose and the bristles are longer. The distal arm of the ninth sternum in *obscura* is straight and finger-like and the apical bristles are short. In *yunkeri* the apex is inflated and there are several stout apical and subapical bristles. The proximal arm of the ninth sternum of *yunkeri* has a subglobular apex but is truncate though somewhat inflated in *obscura.* The details of the aedeagus differ greatly in the two species although the basic design is quite similar. The crochet of *obscura* is a broad, curved, finger-like process which is simple and unadorned. In *yunkeri* it is a rod-like sclerite with a dorsal membranous flap.

DESCRIPTION: *Head, Male* (pl. 90, fig. 1).—Anterior margin of head shallow convexity; preantennal area with 20–21 scattered, fine setae; ocular row of two bristles; anterior arm of tentorium prominent, angular. Eye absent. Maxillary lobe (*MX.*) subacuminate, reaches apex of second segment of four-segmented maxillary palpus (*M.P.*). Genal process projecting ventrad to midpoint on second segment of maxillary palpus. Labial palpus reaches to apex of third segment of maxillary palpus. About 15 fine setae on postantennal area plus patch of about 20 fine setae on dorsal margin and submarginal area of antennal fossa. Second segment of antenna with marginal row of seven or eight delicate setae. Club of antenna subovate; with setae on all but first segment. Tentorial bridge prominent; long, narrow, with laterad-turned apex.

Thorax (pl. 90, fig. 2).—Prontotum with two irregular rows of bristles arranged 6–8; bristles of second row longer than first. Mesonotum (*MSN.*) with irregular row of 10–11 small, thin bristles followed by second row of six long bristles with intercalary setae of same size as bristles of first row; phragma prominent, triangular; flange with two pseudosetae. Mesepisternum (*MPS.*) with single lateral bristle in caudoventral angle; three or four minute setae on cephalodorsal margin. Mesepimere (*MPM.*) with two bristles in cephaloventral corner; third vinculum conspicuous, vermiform. Metanotum (*MTN.*) with first row of nine setae followed by second row of six stouter, longer bristles with intercalary setae; phragma very conspicuous, beak-like. Metepisternum (*MTS.*) with single, long, caudomarginal bristle; internal furca prominent, slightly bent cephalad. Metepimere (*MTM.*) with two long bristles; fourth vinculum crescent-shaped.

Legs.—Forecoxae with scattered bristles which become progressively heavier from base to apex. Mesocoxae with complete diagonal break; prominent notch in caudoventral angle; four stout bristles plus four or five setae on distal one-fifth. Metacoxae with six stout bristles plus several marginal and submarginal setae. Femora with row of 7–12 delicate setae on ventral margin. Tibiae with six (occasionally one metatibia has seven) dorsocaudal notches with stout bristles arranged 1-2-2-2-3; approximately 10 fine setae mediad of notches. One apical bristle of third tarsal segment reaches to apex of fourth segment. Fifth tarsal segment with five pairs plantar bristles; last two pairs delicate; tarsal claws weak.

Abdomen.—Tergum 1 with two rows of bristles preceded by single bristle; first row of eight bristles; second row of about six stout bristles. Terga 2–7 with three rows of bristles; first row incomplete, with four or five thin bristles; second row with 11–12 bristles; third row of eight or nine stout bristles with intercalary setae; dorsal ends of second and third rows bent cephalad. Bases of antesensillial bristles ventrally displaced; bristles slender; in male middle bristle about four times length of dorsal bristle; almost twice length of ventral bristles; in female ventral bristle subequal in length to middle bristle; dorsal bristle about one-half length of middle bristle. Sterna 2–7 each with row of five or six stout bristles preceded by patch of several smaller bristles.

Modified Abdominal Segments, Male (pls. 90, figs. 3–5; 91, figs. 4, 5).—Tergum 8 with broadly rounded apex bearing three or four small marginal bristles ventrad of sensillium. Eighth sternum (*8S.*) a broad caudal process with subtruncate apex bearing 19–20 long marginal-submarginal bristles plus 16–17 shorter medial bristles. Immovable process of clasper (*P.*) with broadly rounded caudal margin; knob-like apex bearing three or four small subapical bristles; medial row of four long bristles plus six smaller bristles ventrad of these. Movable process of clasper (*F.*) only slightly longer than immovable process; with broadly rounded caudal margin; 20–22 small marginal-submarginal setae plus two or three medial setae. Manubrium long, very narrow. Proximal arm of ninth sternum with subglobular apex; distal arm of ninth sternum (*D.A.* 9) inflated subapically on ventral margin to form bulbous apex; three or four stout submarginal bristles plus four or five smaller marginal-submarginal bristles; proximo-caudal margin of arm with eight or nine weak setae.

Aedeagus (pl. 91, fig. 4).—Aedeagal apodeme almost four times as long as broad; long neck; no spur or apical appendage. Median dorsal lobe (*M.D.L.*) straight to slightly sinuate; terminating in flap-like apicomedian sclerite (*AMS*). Sclerotized inner tube (*S.I.T.*) not well defined; with beak-like armature (*A.I.T.*). Crochet (*CR.*) consisting of well sclerotized, rod-like process with slightly swollen apex and dorsal membranous flap. Lateral lobes (*L.L.*) extend to base of crochet; proximoventral margin broadly rounded; distoventral margin straight. Crescent sclerite (*C.S.*) well defined. Penis rods recurved but not coiled.

Modified Abdominal Segments, Female (pl. 91, figs. 1–3).—Seventh sternum (*7S.*) with single caudal lobe; row of eight stout bristles preceded by patch of about eight smaller and two larger bristles. Eighth tergum (*8T.*) with subacuminate caudal margin produced caudad almost to apex of ventral anal lobe; many stout bristles scattered over caudoventral area as well as several smaller bristles near spiracle. Dorsal anal lobe with dense dorsal row of marginal-submarginal bristles plus five or six long bristles on caudoventral angle below anal stylet. Anal stylet about three times as long as wide; with long apical bristle plus too short subapical bristles. Ventral anal lobe well sclerotized; with patches of long bristles on apex and caudoventral angle. Spermatheca subglobular; tail only slightly longer than head.

TYPE MATERIAL: Holotype male (host no. 10252) from *Heteromys desmarestianus,* Boquete Trail, about five miles beyond Cerro Punta (Chiriquí), elevation 6900 feet, 9 March 1962, collected by C. O. Handley and V.

J. Tipton. Allotype female (host no. 10417), same data as the holotype, but 7300 feet elevation, 12 March 1962. Paratypes: A total of 22 males and 21 females same data as the holotype, but from (14) *H. desmarestianus*, between 6800 and 7700 feet elevation and between 7 and 14 March 1962. In addition, 1 male and 1 female (host. no. 7411) same data as holotype, but 7800 feet, collected by C. M. Keenan and C. E. Yunker on 2 May 1961.

Holotype and allotype deposited in the U. S. National Museum; one pair of paratypes deposited with each of the following named institutions and individuals: British Museum (Natural History), Chicago Natural History Museum, Gorgas Memorial Laboratory, Robert Traub and the senior author.

REMARKS: *Wenzella yunkeri* is an extremely interesting species. Although its generic assignment is not in doubt it is certainly distinct from *W. obscura.* Both species were collected from *Heteromys desmarestianus* at high elevations. Heteromyid rodents are rather common in Central America and there are species in South America. However, this is the southernmost extension of the subfamily Rhadinopsyllinae.

This species is named for Dr. Conrad E. Yunker to whom we owe a debt of gratitude for his cooperation and assistance in collecting some of the material reported in this paper.

Family **Stephanocircidae**

Subfamily Craneopsyllinae

Genus **Plocopsylla** Jordan

Plocopsylla Jordan, 1931, Novit. Zool., 37: 138.

Type-species: *Craneopsylla achilles* Rothschild, 1911.

Plocopsylla scotinomi, new species. Plates 92, 93.

DIAGNOSIS: *P. scotinomi* n. sp. is a member of a species complex which includes *hector* Jordan, *heros* Jordan, *ulysses* Hopkins, *phobos* Jordan, *phyllisae* Smit, and *thor* Johnson. In common with these species, *scotinomi* lacks a spine on the genal process, like *hector* it has a tibial comb and in details of the male genitalia and setation it closely resembles *phobos, phyllisae* and *thor. P. scotinomi* may be easily distinguished from *phyllisae* in that the latter species has short stubby, genal spines. The shape and position of the two large spiniform bristles on the distal arm of the ninth sternum serve to separate the remaining three species. In *thor* these two bristles are separated by a distance not much greater than the width of the base of one of the bristles and the ventralmost bristle is enlarged apically so as to resemble a wedge. In *phobos* the distance between the two bristles is equal to or greater than the length of the distalmost of the two bristles and the proximal bristle is rod-shaped and only slightly enlarged apically. In our species the distance between the two bristles is at least twice as great as the length of the distalmost bristle. The proximal bristle is rod-shaped as in *phobos* but is three to four times as long as the distal bristle, not twice as long.

DESCRIPTION: *Head, Male* (pl. 92, fig. 1).—Anterior margin of helmet broadly rounded; pre-ctenidial area narrow, with horizontal striae. Helmet comb of 14 spines in both sexes. Genal comb of four long spines; apex of genal process truncate but caudodorsal angle acute, subacuminate. Two long bristles in preantennal area. Postantennal area with four irregular rows of bristles arranged 5-4-6-7, with some variation. Bristles of scape of antenna do not reach middle of club. Maxillary lobe broad, short, does not extend to midpoint of second segment of 6-segmented labial palpus. Maxillary palpus four-segmented.

Thorax (pl. 92, fig. 2).—Pronotum with two rows of bristles of five bristles each; comb of 14 spines; with broad caudoventral lobe. Mesonotum (*MSN.*) with row of four bristles followed by row of five bristles. Metepisternum (*MPS.*) devoid of bristles. Metepimere (*MPM.*) with four or five bristles. Metanotum (*MTN.*) with two rows of bristles. Lateral metanotal area (*L.M.*) broader than long; with two bristles. Metepisternum (*MTS.*) with one long bristle. Metepimere (*MTM.*) with six long bristles (four broken off in holotype).

Legs.—Procoxae with scattered bristles from base to apex. Meso-metacoxae devoid of bristles except for four or five stout bristles in subapical area. Distal half of all femora with four or five lateral bristles. Partial row of dorsocaudal bristles on fore and middle tibiae. Hind tibiae with seven dorsocaudal notches with bristles arranged 2-2-3-3-3-3-4; with six lateral bristles. None of bristles on tarsal segments reach to apex of next segment.

Abdomen.—First three terga with apical spinelets. All terga with first row of bristles reduced; one exceptionally long bristle on each of first three terga. Male with one antesensillial bristle which barely reaches spiracle. Two antesensillial bristles slightly longer than head of spermatheca.

Modified Abdominal Segments, Male (pls. 92, figs. 3–5; 93, figs. 1, 2).—Eighth tergum (*8T.*) short, caudal margin truncate. Eighth sternum (*8S.*) with short, narrow process devoid of setae. Finger-like distal arm of ninth sternum (*9S.*) with two modified setae about midway on caudal margin; proximal bristle approximately same diameter for its length, almost one-half length of distal arm of ninth sternum; distal bristle short, about one-quarter length of lower bristle; two bristles separated by distance equal to three-quarters length of longer bristle; two thin apical-subapical bristles. Immovable process of clasper (*P.*) very prominent, extends caudad of other elements of genitalia; with about 12 long marginal bristles; about four shorter marginal, six medial bristles. Internal sclerite five times longer than wide with sides roughly parallel. Movable process of clasper (*F.*) bent sharply dorsad so that distal half is at right angle to proximal half; bulbous subapically with apex acuminate; medial bristle proximad of swollen portion modified, spindle-shaped, bent, striated; three or four medial microsetae, one marginal seta on bulbous portion plus subapical seta.

Aedeagus (pl. 93, fig. 1).—Distolateral lobe (*D.L.L.*) with broad apex; internal sclerotized band reaching to apex. Crochet (*CR.*) poorly developed; short, narrow band enlarged slightly in middle. Lateral lobe (*L.L.*) long, narrow. Sclerotized inner tube (*S.I.T.*) short, curved caudad. Lateral sclerite (*L.S.I.*) spade-like.

Modified Abdominal Segments, Female (pl. 93, figs. 3–5).—Caudal margin of seventh sternum (*7S.*) undulating but with no pronounced lobes or sinuses; with two rows of bristles of four bristles each plus three bristles cephalodorsad of rows. Eighth tergum (*8T.*) with five bristles in first row, three bristles in second row plus two bristles not in rows. Eighth sternum (*8S.*) with ventral patch of 12–14 bristles plus two additional bristles dorsad of patch. Dorsal anal lobe of proctiger reduced; with three bristles plus short spiniform cephalad of anal stylet; two bristles dorsad of anal stylet. Ventral anal lobe of proctiger with two bristles. Anal stylet almost three times as long as broad; long subapical bristles plus two shorter apical bristles. Head of spermatheca oblong, twice as long as tail.

TYPE MATERIAL: Holotype male (host no. 7409) from *Scotinomys xerampelinus* on Boquete Trail, about five miles beyond Cerro Punta (Chiriquí), elevation 7800 feet, 2 May 1961, collected by C. M. Keenan and C. E. Yunker. Allotype female, same data as the holotype. Paratypes: 1 female (host no. 6832), same data but elevation 6800 feet, 7 January 1961; 5 males and 10 females, same data, but from 14 host animals from 6900 to 7800 feet elevation, 7 to 15 March 1962, collected by C. O. Handley and V. J. Tipton. Holotype and allotype deposited in the United States National Museum; 1 pair of paratypes each deposited in the collections of the following institutions and individuals: British Museum (Natural History), Chicago Natural History Museum, Gorgas Memorial Laboratory, Robert Traub, and the senior author.

REMARKS: This is the first record of a stephanocircid flea in Central America. However, it is not an unusual finding in view of the host relationships. Species of the genus *Scotinomys* apparently fill the same ecological niche in Central America as that occupied by species of the closely related genus *Akodon* in South America.

Host-Parasite Relationships

Although our data are insufficient to be conclusive, some broad patterns are apparent. In Panama the flea fauna is much richer at high elevations (above 5000 feet). Host specificity is rather loose, two or three host genera, or perhaps a family, harboring a single species of flea. The flea fauna of a host group at low elevations, when it exists, is distinct from that of the same host group at high elevations.

There are some 95 recorded species of bats in Panama representing 40 genera and seven families. Only two bat families contain species which have been found to harbor fleas even though hundreds of bats of each family have been collected. *Myotis nigricans, Tadarida yucatanica, T. brasiliensis* and *Molossus coibensis,* the only species on which fleas have been found consistently, all live in closely-knit colonies. The molossids generally live under roof tile, under eaves or in low-ceilinged caves only a few inches from their droppings, making it a comparatively simple matter for adult fleas to gain access to a host. Generally, these bat species appear to rather consistently utilize the same roosts year after year. Whether or not a bat species harbors fleas may be determined in large measure by its roosting habits.

From sea level to the highest elevations where they are found in Panama, marsupials are infested with fleas, but below 2500 feet they apparently have no distinctive flea fauna. Both *Adoratopsylla intermedia* and *Juxtapulex echidnophagoides* occur in large numbers on *Didelphis marsupialis etensis* at elevations in excess of 5000 feet, but it is likely that the latter flea species is more commonly associated with the common armadillo.

Of the seven species of edentates in Panama, only one, the common armadillo, is consistently parasitized with fleas. At low elevations *Rhopalopsyllus cacicus saevus* is numerous on this host as well as in burrows, while *J. echidnophagoides* was collected from all host specimens obtained above 5000 feet.

There is a rich and interesting flea fauna on cricetid rodents above 5000 feet elevation but virtually none on cricetid hosts collected at low elevations. This is also true of the squirrels. However, fleas are commonly found on one species of pocket mouse and some hystrichomorph rodents at low elevations. The number of fleas found on carnivores and larger animals, including domestic animals and man, has not been great although the cat flea is abundant on cats and dogs in most localities.

HOST-PARASITE LIST
By Elevation

For each host (bold face type) listed below, column 1 shows the total number of specimens found to be infested by fleas (numerator), followed by the total number examined for parasites (denominator). Columns 2, 3, and 4 show these totals divided according to elevations of collecting localities. Some hosts which were found to be negative for fleas are also included.

Parasite statistics (light face) indicate the numbers of males (m) and females (f) for each species of fleas taken from the respective host, according to elevation of collecting localities.

Hosts and Parasites	**Host Totals**	**From Elevations:**		
		below 2500 ft.	*2500–5000 ft.*	*over 5000 ft.*
Class AVES				
Order STRIGIFORMES Family Strigidae				
Glaucidium jardinii	1/2	..	..	1/2
Ceratophyllus altus n. sp.		..	..	1m/
Order PASSERIFORMES Family Ptilogonatidae				
Ptilogonys caudatus	1/1	..	..	1/1
Dasypsyllus gallinulae perpinnatus (Baker)		..	..	/1f
Family Hirundinidae				
Notiochelidon cyanoleuca	1/1	..	..	1/1
Dasypsyllus lasius venezuelensis (I. Fox and Anduze)		..	..	/1f
Class MAMMALIA				
Order MARSUPIALIA Family Didelphidae				
Caluromys derbianus	0/11	0/10	0/1	..
Monodelphis adusta	0/1	0/1	..	..

Hosts and Parasites	Host Totals	From Elevations:		
		below 2500 ft.	*2500–5000 ft.*	*over 5000 ft.*
Marmosa mexicana	0/2	0/2	..	..
Marmosa robinsoni	5/108	3/86	2/19	0/3
Adoratopsylla intermedia copha (Jordan)		/1f	3m/2f	..
Polygenis roberti beebei (I. Fox)		/1f	/2f	..
Polygenis klagesi (Rothschild)		2m/1f	..	..
Philander opossum	15/109	6/91	9/18	..
Adoratopsylla intermedia copha (Jordan)		2m/	33m/28f	..
Rhopalopsyllus australis tupinus J. and R.		/1f	..	..
Rhopalopsyllus cacicus saevus J. and R.		/5f	..	..
Polygenis roberti beebei (I. Fox)		1m/	/2f	..
Metachirus nudicaudatus	27/41	0/7	27/34	..
Adoratopsylla intermedia copha (Jordan)		..	199m/190f	..
Rhopalopsyllus cacicus saevus J. and R.		..	/1f	..
Polygenis roberti beebei (I. Fox)		..	1m/	..
Polygenis dunni (J. and R.)		..	/2f	..
Didelphis marsupialis	43/207	23/183	9/12	11/12
Adoratopsylla intermedia copha (Jordan)		..	30m/28f	108m/157f
Juxtapulex echidnophagoides Wagner		..	..	78m/138f
Hoplopsyllus glacialis exoticus J. and R.		..	..	5m/3f
Ctenocephalides felis felis (Bouché)		2m/2f	3m/2f	11m/27f
Pleochaetis dolens dolens (J. and R.)		..	..	4m/8f
Rhopalopsyllus lugubris lugubris (J. and R.)		7m/2f	/1f	
Rhopalopsyllus australis tupinus J. and R.		2m/5f	..	/1f
Rhopalopsyllus cacicus saevus J. and R.		5m/10f	1m/2f	..
Polygenis klagesi (Rothschild)		3m/7f	..	..
Polygenis roberti beebei (I. Fox)		/2f	3m/5f	..
Chironectes minimus	1/2	1/2	..	..
Rhopalopsyllus australis tupinus J. and R.		3m/3f	..	..
Order INSECTIVORA Family Soricidae				
Cryptotis nigrescens	0/4	..	..	0/4
Order CHIROPTERA Family Vespertilionidae				
Myotis albescens	0/1	0/1	..	..
Myotis chiloensis	0/1	..	..	0/1
Myotis nigricans	7/143	0/94	0/1	7/48
Sternopsylla distincta speciosa Johnson		..	..	11m/12f

Hosts and Parasites	Host Totals	From Elevations: below 2500 ft.	2500–5000 ft.	over 5000 ft.
Mixed collection of **Myotis chiloensis** (78) and **Myotis nigricans** (30)	3/108	..	..	3/108
Sternopsylla distincta speciosa Johnson		..	..	1m/3f
Eptesicus chiriquinus	0/1	..	..	0/1
Eptesicus fuscus	0/2	..	0/2	..
Rhogeessa tumida	0/14	0/14	..	..
Lasiurus borealis	0/1	0/1	..	..
Lasiurus ega	0/1	0/1	..	..
Family Molossidae				
Molossops planirostris	0/15	0/15	..	..
Tadarida brasiliensis	2/8	0/1	..	2/7
Sternopsylla distincta speciosa Johnson		..	..	2m/1f
Tadarida yucatanica	60/88	58/86	..	2/2
Sternopsylla distincta speciosa Johnson		..	..	1m/1f
Ptilopsylla dunni Kohls		83m/163f	..	..
Hormopsylla kyriophila n. sp.		2m/9f	..	..
Rhynchopsyllus megastigmata Traub and Gammons		/1f	..	..
Bat guano (from roosting place of *Tadarida yucatanica*)	3/3	3/3	..	..
Ptilopsylla dunni Kohls		2667m/5305f	..	..
Rhynchopsyllus megastigmata Traub and Gammons		4m/3f	..	..
Hormopsylla kyriophila n. sp.		11m/5f	..	..
Molossus bondae	0/32	0/32	..	..
Molossus coibensis	25/222	25/222	..	..
Ptilopsylla dunni Kohls		66m/129f	..	..
Hormopsylla kyriophila n. sp.		/3f	..	..
Molossus sinaloae	0/13	0/13	..	..
Promops centralis	0/11	0/11	..	..
Eumops auripendulus	0/4	0/4	..	..
Eumops bonariensis	0/1	0/1	..	..
Bat guano (from roosting place of *Myotis nigricans*, *M. chiloensis*, and *Tadarida brasiliensis*)	1/1	..	..	1/1
Sternopsylla distincta speciosa Johnson		..	..	313m/250f

Hosts and Parasites	Host Totals	From Elevations: *below 2500 ft.*	*2500–5000 ft.*	*over 5000 ft.*
Order PRIMATES Family Hominidae				
Homo sapiens	14/25	11/18	..	3/7
Ctenocephalides felis felis (Bouché)		9m/6f	..	/1f
Pulex simulans Baker		30m/51f	..	..
Rhopalopsyllus lugubris lugubris J. and R.		/1f	..	..
Rhopalopsyllus lugubris cryptoctenes (Enderlein)		..	..	1m/1f
Rhopalopsyllus australis tupinus J. and R.		/4f	..	..
Juxtapulex echidnophagoides Wagner		..	..	/1f
Order EDENTATA Family Myrmecophagidae				
Tamandua tetradactyla	2/7	1/5	1/2	..
Rhopalopsyllus australis tupinus J. and R.		/1f	2m/1f	..
Cyclopes didactylus	0/3	0/3	..	..
Bradypus infuscatus	0/9	0/8	0/1	..
Choloepus hoffmanni	0/5	0/5	..	..
Cabassous centralis	0/2	0/2	..	..
Dasypus novemcinctus	18/20	11/13	..	7/7
Juxtapulex echidnophagoides Wagner		..	..	273m/326f
Rhopalopsyllus cacicus saevus J. and R.		77m/104f	..	..
Order LAGOMORPHA Family Leporidae				
Sylvilagus brasiliensis	7/14	3/9	0/1	4/4
Ctenocephalides felis felis (Bouché)		/1f	..	..
Hoplopsyllus glacialis exoticus J. and R.		..	..	24m/47f
Rhopalopsyllus australis tupinus J. and R.		1m/2f	..	..
Order RODENTIA Family Sciuridae				
Sciurus granatensis	46/129	0/63	3/10	43/56
Pleochaetis dolens dolens (J. and R.)		..	..	104m/141f
Kohlsia graphis graphis (Rothschild)		..	..	5m/11f
Kohlsia tiptoni Mendez and Altman		..	..	/1f
Kohlsia traubi Tipton and Mendez		..	..	/3f
Dasypsyllus gallinulae perpinnatus (Baker)		..	..	2m/6f
Strepsylla dalmati Traub and Barrera		..	..	1m/2f

Hosts and Parasites	Host Totals	From Elevations: *below 2500 ft.*	*2500–5000 ft.*	*over 5000 ft.*
Sciurus granatensis (cont.)				
Polygenis dunni (J. and R.)		..	/1f	..
Polygenis roberti beebei (I. Fox)		..	/1f	..
Rhopalopsyllus australis tupinus J. and R.		..	1m/	..
Rhopalopsyllus sp.		..	..	/1f
Juxtapulex echidnophagoides Wagner		..	..	1m/
Sciurus variegatoides	**0/6**	**0/5**	**0/1**	..
Microsciurus alfari	**0/3**	..	**0/3**	..
Family Geomyidae				
Macrogeomys cavator	**0/5**	..	..	**0/5**
Family Heteromyidae				
Liomys adspersus	**11/62**	**11/61**	**0/1**	..
Polygenis dunni (J. and R.)		19m/19f	..	..
Polygenis klagesi (Rothschild)		/2f	..	..
Ctenocephalides felis felis (Bouché)		1m/	..	..
Heteromys australis	**1/21**	**1/11**	**0/9**	**0/1**
Polygenis klagesi (Rothschild)		/1f	..	..
Heteromys desmarestianus	**18/80**	**0/4**	**1/42**	**17/34**
Pleochaetis dolens dolens (J. and R.)		..	..	1m/
Wenzella yunkeri n. sp.		..	..	25m/34f
Polygenis roberti beebei (I. Fox)		..	/1f	..
Kohlsia traubi Tipton and Mendez		..	..	1m/
Family Cricetidae				
Oryzomys albigularis	**7/25**	..	..	**7/25**
Pleochaetis altmani Tipton and Mendez		..	..	1m/2f
Pleochaetis dolens dolens (J. and R.)		..	..	/3f
Kohlsia keenani Tipton and Mendez		..	..	1m/1f
Polygenis atopus (J. and R.)		..	..	1m/
Oryzomys alfaroi	**7/26**	..	**3/5**	**4/21**
Kohlsia keenani Tipton and Mendez		..	..	/2f
Kohlsia traubi Tipton and Mendez		..	..	1m/1f
Pleochaetis dolens dolens (J. and R.)		..	..	1m/3f
Polygenis roberti beebei (I. Fox)		..	3m/4f	..
Oryzomys bombycinus	**3/7**	..	**3/7**	..
Polygenis roberti beebei (I. Fox)		..	5m/5f	..
Polygenis klagesi (Rothschild)		..	/2f	..

Hosts and Parasites	Host Totals	From Elevations:		
		below 2500 ft.	*2500–5000 ft.*	*over 5000 ft.*
Oryzomys caliginosus	**19/94**	**1/24**	**18/70**	..
Polygenis roberti beebei (I. Fox)		1m/1f	13m/28f	..
Adoratopsylla intermedia copha (Jordan)		/1f	1m/1f	..
Ctenocephalides felis felis (Bouché)		..	/1f	..
Rhopalopsyllus lugubris lugubris J. and R.		..	1m/	..
Oryzomys capito	**21/100**	**4/57**	**17/43**	..
Polygenis roberti beebei (I. Fox)		/1f	26m/22f	..
Polygenis klagesi (Rothschild)		1m/1f	1m/1f	..
Polygenis dunni (J. and R.)		/1f	..	..
Jellisonia sp.		..	/1f	..
Oryzomys fulvescens	**12/44**	**0/2**	**0/1**	**12/41**
Pleochaetis dolens dolens (J. and R.)		..	..	1m/6f
Strepsylla dalmati Traub and Barrera		..	..	/1f
Kohlsia keenani Tipton and Mendez		..	..	2m/4f
Kohlsia traubi Tipton and Mendez		..	..	/2f
Pleochaetis altmani Tipton and Mendez		..	..	2m/2f
Nectomys alfari	**2/3**	..	**2/3**	..
Polygenis roberti beebei (I. Fox)		..	2m/4f	..
Tylomys panamensis	**5/9**	**3/7**	**2/2**	..
Polygenis klagesi (Rothschild)		11m/16f	2m/2f	..
Nyctomys sumichrasti	**1/4**	..	**0/2**	**1/2**
Pleochaetis dolens dolens (J. and R.)		..	..	/3f
Reithrodontomys creper	**36/67**	..	..	**36/67**
Jellisonia johnsonae Tipton and Mendez		..	..	1m/
Strepsylla dalmati Traub and Barrera		..	..	2m/3f
Pleochaetis altmani Tipton and Mendez		..	..	28m/29f
Pleochaetis dolens dolens (J. and R.)		..	..	2m/4f
Juxtapulex echidnophagoides Wagner		..	..	1m/
Kohlsia traubi Tipton and Mendez		..	..	1m/
Reithrodontomys mexicanus	**9/40**	..	..	**9/40**
Pleochaetis altmani Tipton and Mendez		..	..	4m/1f
Pleochaetis dolens dolens (J. and R.)		..	..	4m/8f
Jellisonia johnsonae Tipton and Mendez		..	..	/2f
Strepsylla dalmati Traub and Barrera		..	..	1m/1f
Reithrodontomys sumichrasti	**18/67**	..	..	**18/67**
Jellisonia johnsonae Tipton and Mendez		..	..	3m/10f
Pleochaetis dolens dolens (J. and R.)		..	..	8m/6f
Pleochaetis altmani Tipton and Mendez		..	..	2m/
Strepsylla dalmati Traub and Barrera		..	..	1m/
Peromyscus flavidus	**4/7**	..	**4/6**	**0/1**
Kohlsia azuerensis n. sp.		..	6m/7f	..

Hosts and Parasites	Host Totals	From Elevations: below 2500 ft.	2500–5000 ft.	over 5000 ft.
Peromyscus nudipes	182/322	..	1/1	181/ 321
Kohlsia traubi Tipton and Mendez		..	..	180m/177f
Kohlsia keenani Tipton and Mendez		..	..	2m/3f
Kohlsia mojica n. sp.		..	..	18m/16f
Pleochaetis dolens dolens (J. and R.)		..	..	47m/58f
Pleochaetis altmani Tipton and Mendez		..	..	5m/12f
Jellisonia johnsonae Tipton and Mendez		..	..	6m/3f
Strepsylla dalmati Traub and Barrera		..	..	5m/9f
Polygenis atopus (J. and R.)		..	..	2m/3f
Polygenis roberti beebei (I. Fox)		..	/1f	..
Ctenocephalides felis felis (Bouché)		..	1m/	..
Zygodontomys microtinus	9/74	5/61	4/13	..
Polygenis klagesi (Rothschild)		1m/5f	2m/3f	..
Polygenis roberti beebei (I. Fox)		..	1m/2f	..
Polygenis dunni (J. and R.)		1m/1f	..	..
Rhopalopsyllus australis tupinus J. and R.		1m/1f	..	..
Rhopalopsyllus lugubris lugubris J. and R.		/1f	..	..
Scotinomys teguina	16/38	..	..	16/38
Jellisonia johnsonae Tipton and Mendez		..	..	14m/27f
Kohlsia keenani Tipton and Mendez		..	..	/1f
Pleochaetis dolens dolens (J. and R.)		..	..	1m/3f
Plocopsylla scotinomi n. sp.		..	..	/1f
Scotinomys xerampelinus	37/83	..	..	37/83
Jellisonia johnsonae Tipton and Mendez		..	..	4m/
Kohlsia keenani Tipton and Mendez		..	..	/2f
Pleochaetis altmani Tipton and Mendez		..	..	16m/12f
Pleochaetis dolens dolens (J. and R.)		..	..	4m/5f
Plocopsylla scotinomi n. sp.		..	..	6m/11f
Strepsylla dalmati Traub and Barrera		..	..	1m/4f
Sigmodon hispidus	2/153	2/152	0/1	..
Polygenis dunni (J. and R.)		1m/	..	..
Polygenis klagesi (Rothschild)		/1f	..	..

Family Muridae

Hosts and Parasites	Host Totals	below 2500 ft.	2500–5000 ft.	over 5000 ft.
Rattus norvegicus	1/12	1/12	..	..
Pulex simulans Baker		1m/4f	..	..
Rattus rattus	3/110	2/97	1/13	..
Xenopsylla cheopis Rothschild		2m/4f	1m/1f	..
Mus musculus Linnaeus	1/17	..	..	1/17
Pleochaetis dolens dolens (J. and R.)		..	..	1m/

Hosts and Parasites	Host Totals	From Elevations:		
		below 2500 ft.	*2500–5000 ft.*	*over 5000 ft.*
Family Erethizontidae				
Coendou mexicanus	4/5	..	..	4/5
Polygenis klagesi (Rothschild)		..	..	8m/25f
Ctenocephalides felis felis (Bouché)		..	..	/1f
Juxtapulex echidnophagoides Wagner		..	..	1m/
Coendou rothschildi	0/4	0/4	..	..
Family Hydrochaeridae				
Hydrochaeris hydrochaeris	0/2	..	0/2	..
Family Dasyproctidae				
Agouti paca	10/13	3/4	4/6	3/3
Rhopalopsyllus lugubris lugubris J. and R.		11m/14f	4m/2f	..
Rhopalopsyllus lugubris cryptoctenes (Enderlein)		..	..	51m/64f
Rhopalopsyllus cacicus saevus J. and R.		1m/	..	..
Rhopalopsyllus australis tupinus J. and R.		..	7m/8f	/3f
Dasyprocta punctata	23/35	18/26	5/9	..
Rhopalopsyllus australis tupinus J. and R.		64m/91f	32m/39f	..
Rhopalopsyllus cacicus saevus J. and R.		/2f	..	..
Rhopalopsyllus lugubris lugubris J. and R.		2m/3f	/1f	..
Polygenis klagesi (Rothschild)		1m/3f	..	..
Family Echimyidae				
Proechimys semispinosus	314/616	294/595	20/21	..
Polygenis klagesi (Rothschild)		815m/1153f	151m/194f	..
Polygenis dunni (J. and R.)		2m/1f	..	..
Polygenis roberti beebei (I. Fox)		..	2m/2f	..
Adoratopsylla intermedia copha (Jordan)		..	/1f	..
Rhopalopsyllus lugubris lugubris J. and R.		/1f	..	..
Rhopalopsyllus australis tupinus J. and R.		3m/11f	..	..
Rhopalopsyllus cacicus saevus J. and R.		1m/3f	..	..
Hoplomys gymnurus	5/9	2/3	3/6	..
Polygenis klagesi (Rothschild)		5m/11f	25m/40f	..
Diplomys labilis	0/3	0/3	..	..
Order CARNIVORA				
Family Procyonidae				
Procyon cancrivorus	0/2	0/2	..	..

Hosts and Parasites	Host Totals	From Elevations: below 2500 ft.	2500–5000 ft.	over 5000 ft.
Procyon lotor	1/1	..	..	1/1
Pleochaetis dolens dolens (J. and R.)		..	..	/1f
Nasua nasua	14/27	10/23	1/1	3/3
Pleochaetis dolens dolens (J. and R.)		..	..	/1f
Rhopalopsyllus lugubris cryptoctenes (Enderlein)		..	..	4m/4f
Rhopalopsyllus australis tupinus J. and R.		24m/31f	/2f	/1f
Rhopalopsyllus cacicus saevus J. and R.		1m/1f	..	..
Polygenis klagesi (Rothschild)		19m/24f	..	..
Dasypsyllus gallinulae perpinnatus (Baker)		..	..	1m/
Ctenocephalides felis felis (Bouché)		5m/9f	..	/1f
Hoplopsyllus glacialis exoticus J. and R.		..	..	/2m
Potos flavus	0/5	0/2	..	0/3
Bassaricyon gabbii	2/3	0/1	..	2/2
Pleochaetis dolens dolens (J. and R.)		..	..	5m/9f
Jellisonia johnsonae Tipton and Mendez		..	..	/1f
Family Mustelidae				
Mustela frenata	1/1	..	..	1/1
Pleochaetis dolens dolens (J. and R.)		..	..	/1f
Eira barbara	2/3	1/1	1/2	..
Rhopalopsyllus australis tupinus J. and R.		..	/1f	..
Ctenocephalides felis felis (Bouché)		4m/5f	..	..
Galictis allamandi	1/1	1/1	..	..
Rhopalopsyllus australis tupinus J. and R.		/1f	..	..
Conepatus semistriatus	1/1	..	..	1/1
Ctenocephalides felis felis (Bouché)		..	..	2m/5f
Pulex irritans Linnaeus		..	..	/2f
Lutra annectens	0/1	..	..	0/1
Family Canidae				
Canis familiaris	23/30	19/23	..	4/7
Ctenocephalides felis felis (Bouché)		161m/412f	..	2m/9f
Juxtapulex echidnophagoides Wagner		..	..	1m/1f
Rhopalopsyllus australis tupinus J. and R.		..	..	/1f
Family Felidae				
Felis cattus	6/6	5/5	1/1	..
Ctenocephalides felis felis (Bouché)		135m/197f	3m/9f	..

Hosts and Parasites	Host Totals	From Elevations:		
		below 2500 ft.	*2500–5000 ft.*	*over 5000 ft.*
Felis onca	1/3	0/1	1/2	..
Juxtapulex echidnophagoides Wagner		..	19m/19f	..
Ctenocephalides felis felis (Bouché)		..	/1f	..
Felis pardalis	0/1	0/1	..	..
Felis yagouaroundi	0/1	..	0/1	..
Order PERISSODACTYLA Family Tapiridae				
Tapirella bairdii	0/1	..	0/1	..
Order ARTIODACTYLA Family Tayassuidae				
Tayassu pecari	0/5	..	..	0/5
Tayassu tajacu	1/1	1/1	..	..
Rhopalopsyllus australis tupinus J. and R.				
Family Suidae				
Sus scrofa	4/4	2/2	2/2	..
Tunga penetrans (Linnaeus)		17m/4f	14m/5f	..
Family Cervidae				
Odocoileus virginianus	0/4	0/2	0/2	..
NESTS				
Rodent nests	2/8	..	..	2/8
Jellisonia johnsonae Tipton and Mendez		..	..	5m/5f
Pleochaetis dolens dolens (J. and R.)		..	..	8m/16f
Bird nests	3/4	..	..	3/4
Dasypsyllus gallinulae perpinnatus (Baker)		..	..	5m/9f
Dasypsyllus lasius venezuelensis (I. Fox and Anduze)		..	..	194m/247f
Animal burrows (probably Armadillo)	16/20	16/20	..	..
Rhopalopsyllus cacicus saevus J. and R.		105m/159f	..	..

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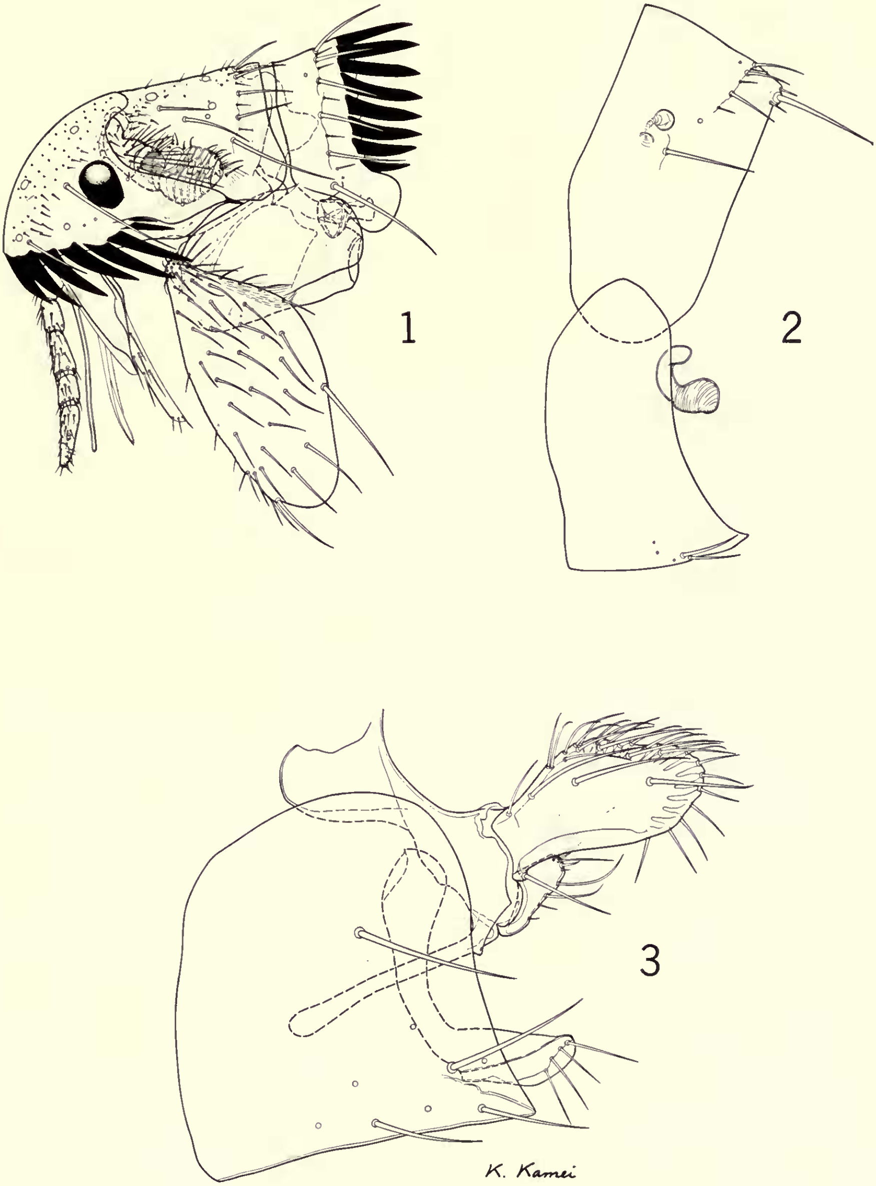
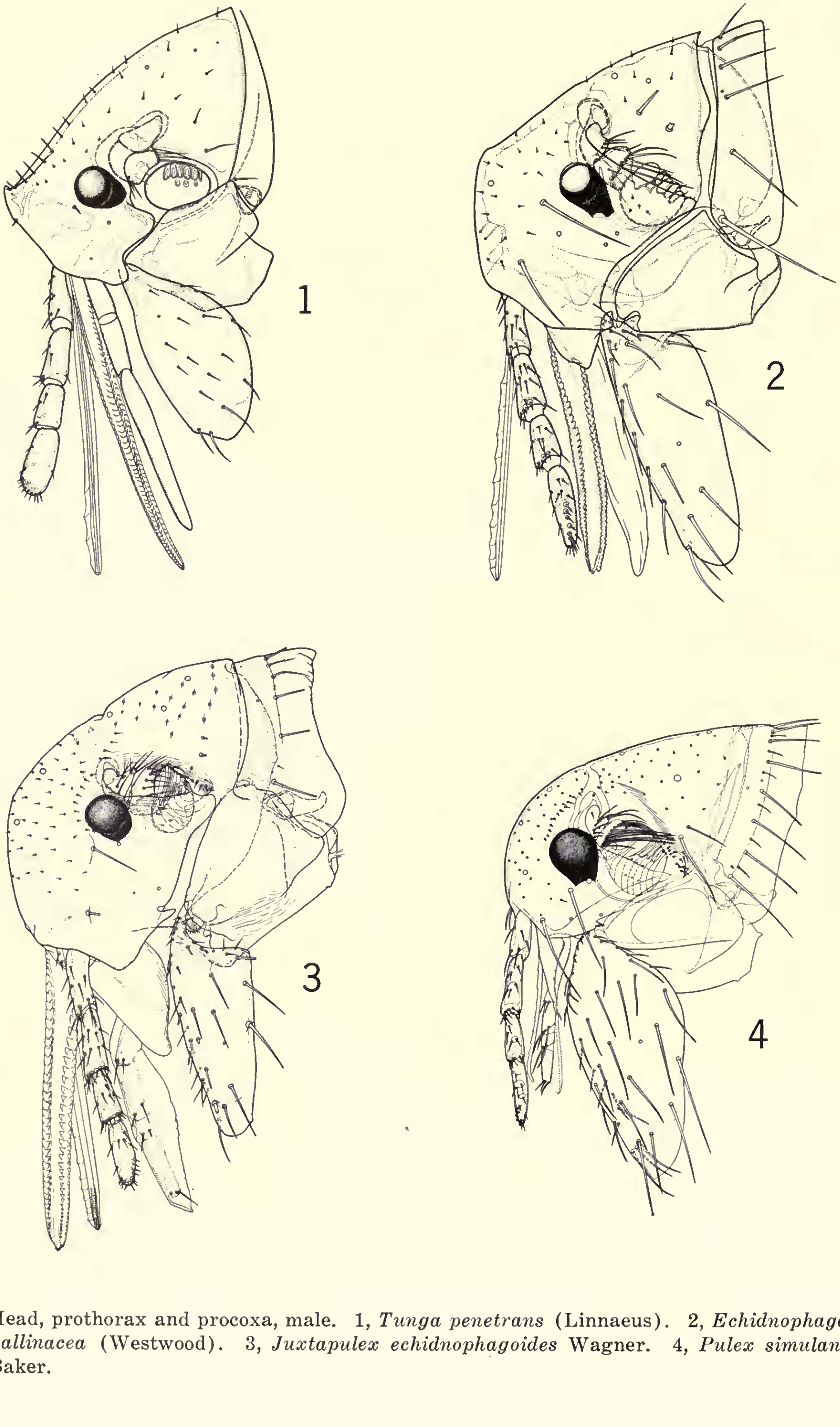
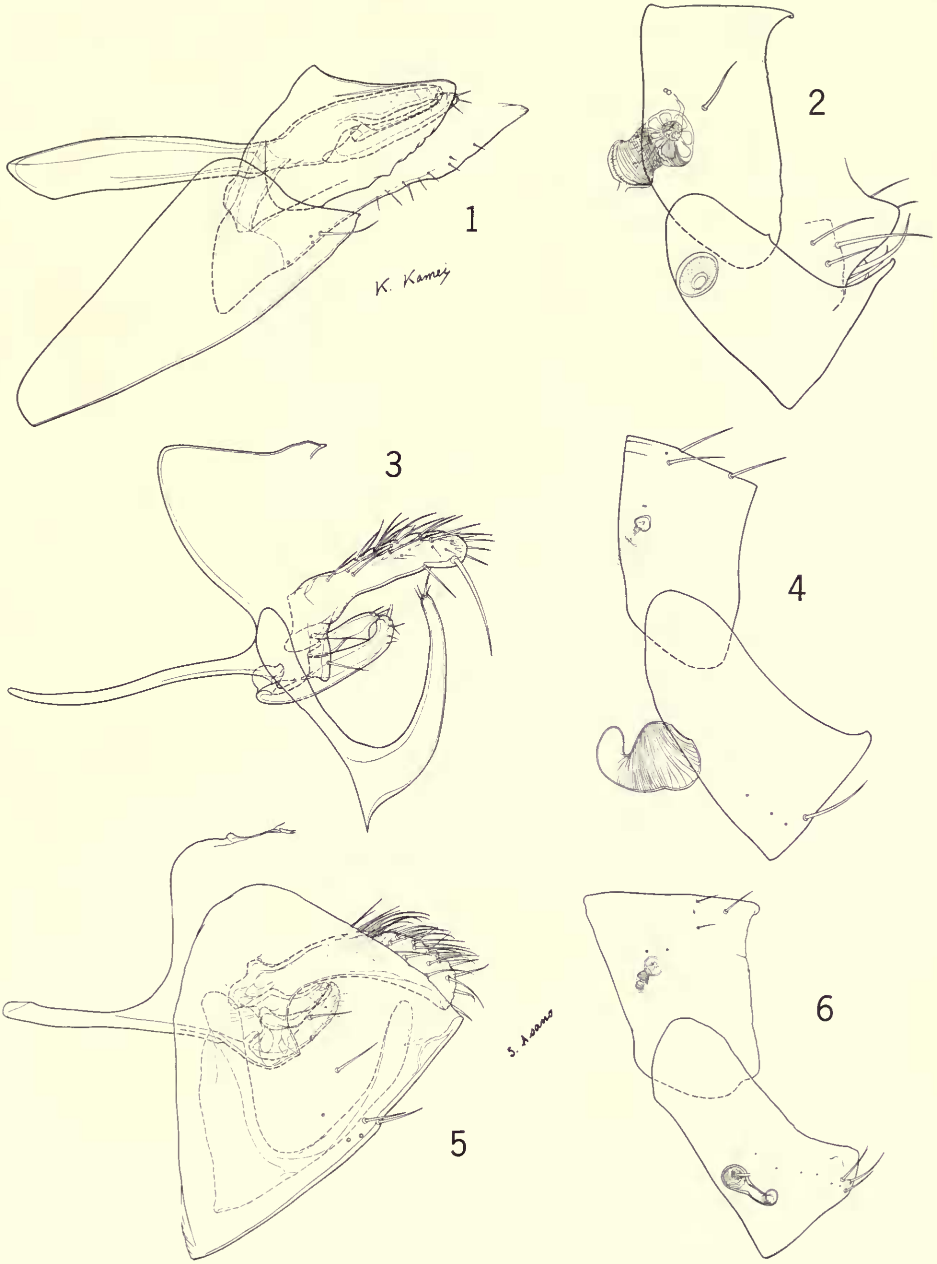


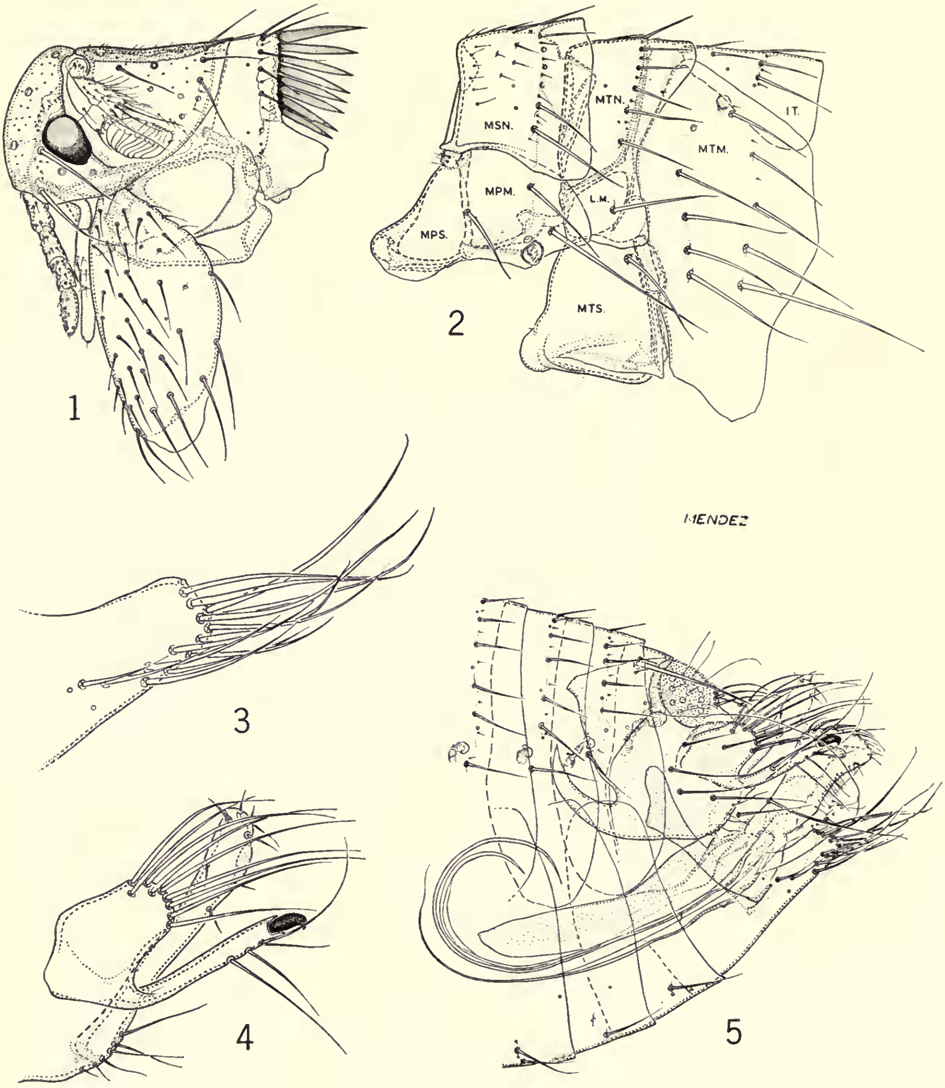
Ctenocephalides felis felis (Bouché). 1, male, head, prothorax and procoxa. 2, female, spermatheca and seventh abdominal segment. 3, male genitalia.



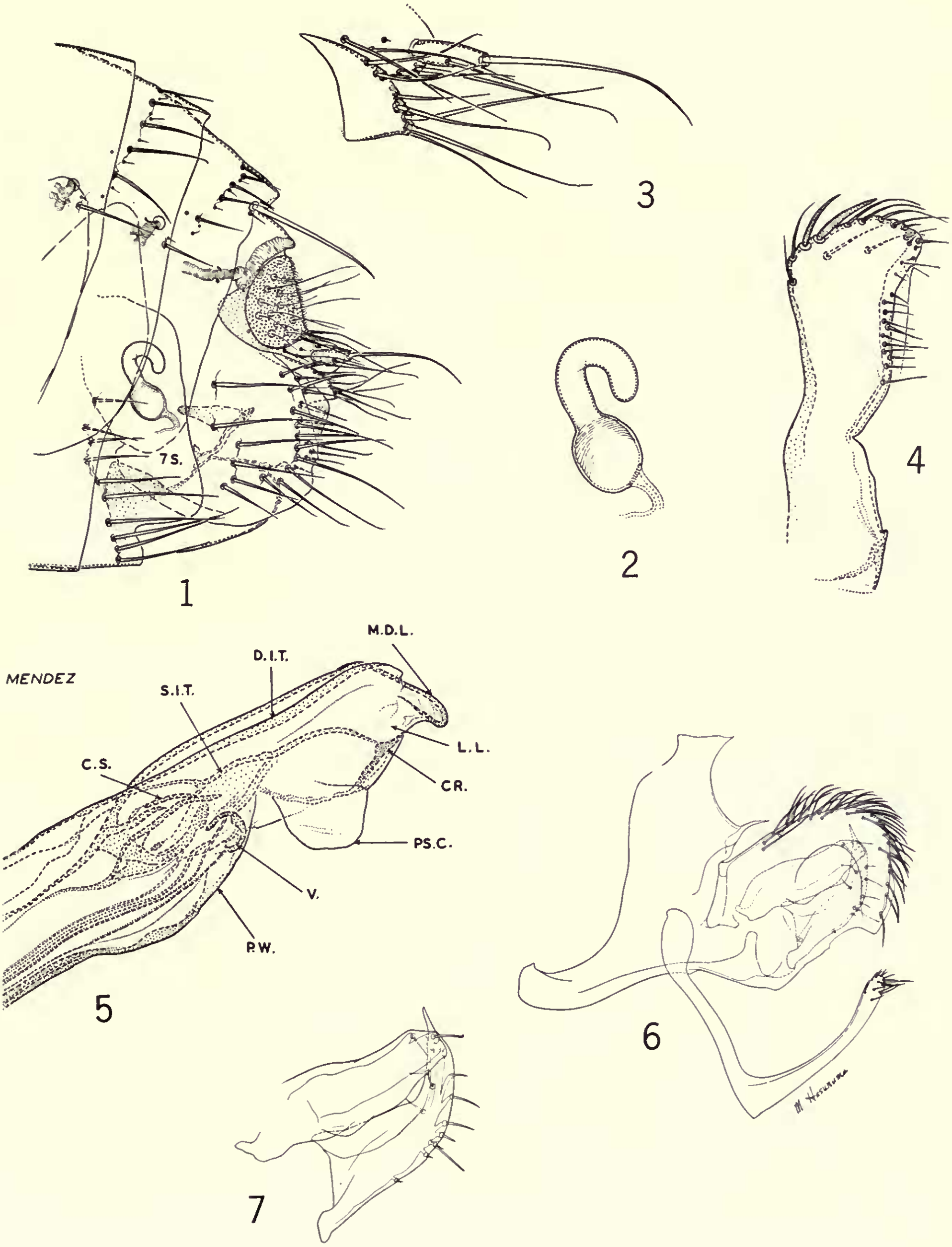
Head, prothorax and procoxa, male. 1, *Tunga penetrans* (Linnaeus). 2, *Echidnophaga gallinacea* (Westwood). 3, *Juxtapulex echidnophagoides* Wagner. 4, *Pulex simulans* Baker.



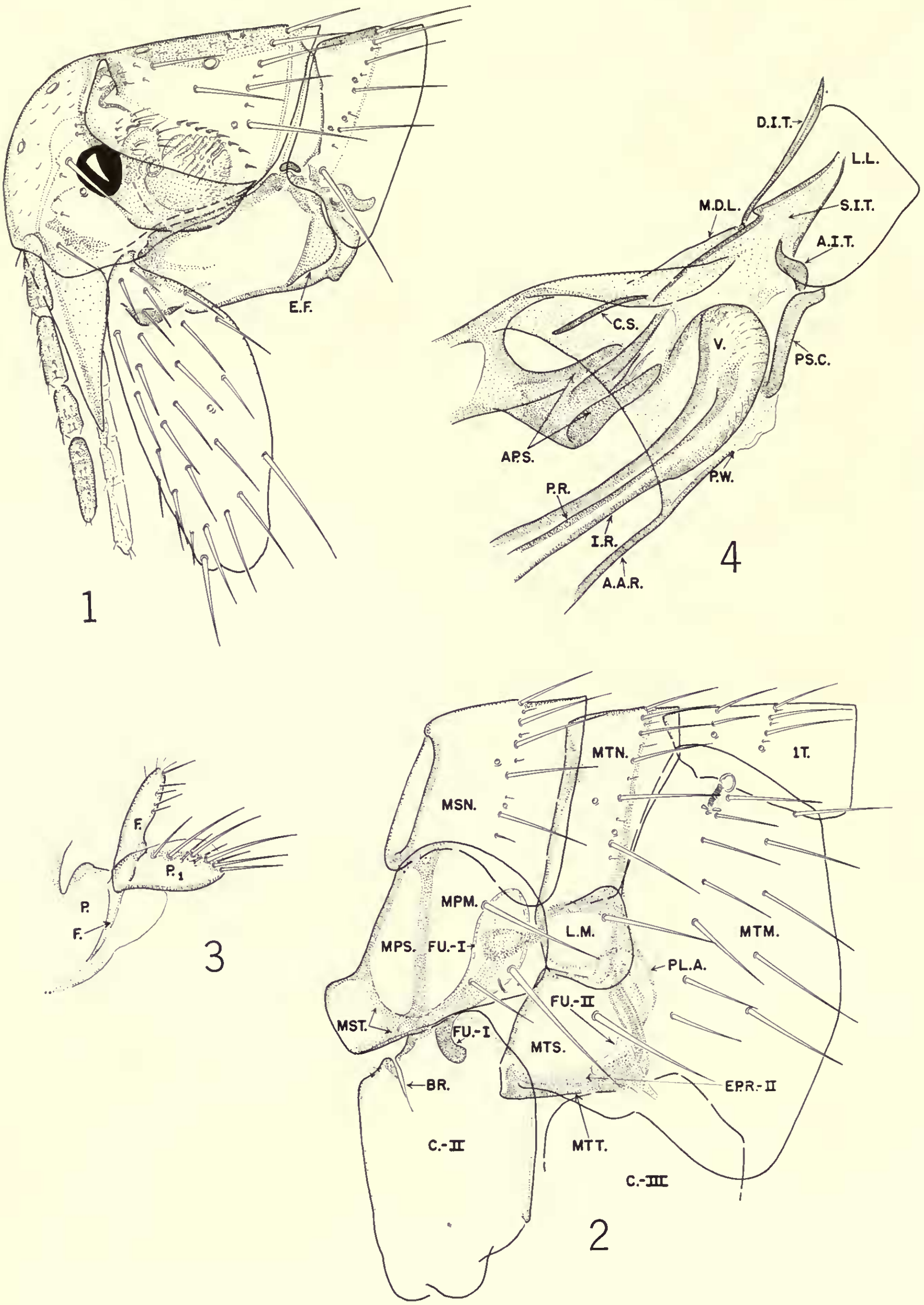
Tunga penetrans (Linneaus). 1, male genitalia. 2, female, spermatheca and seventh abdominal segment. *Echidnophaga gallinacea* (Westwood). 3, male genitalia. 4, female, spermatheca and seventh abdominal segment. *Juxtapulex echidnophagoides* Wagner. 5, male genitalia. 6, female, spermatheca and seventh abdominal segment.



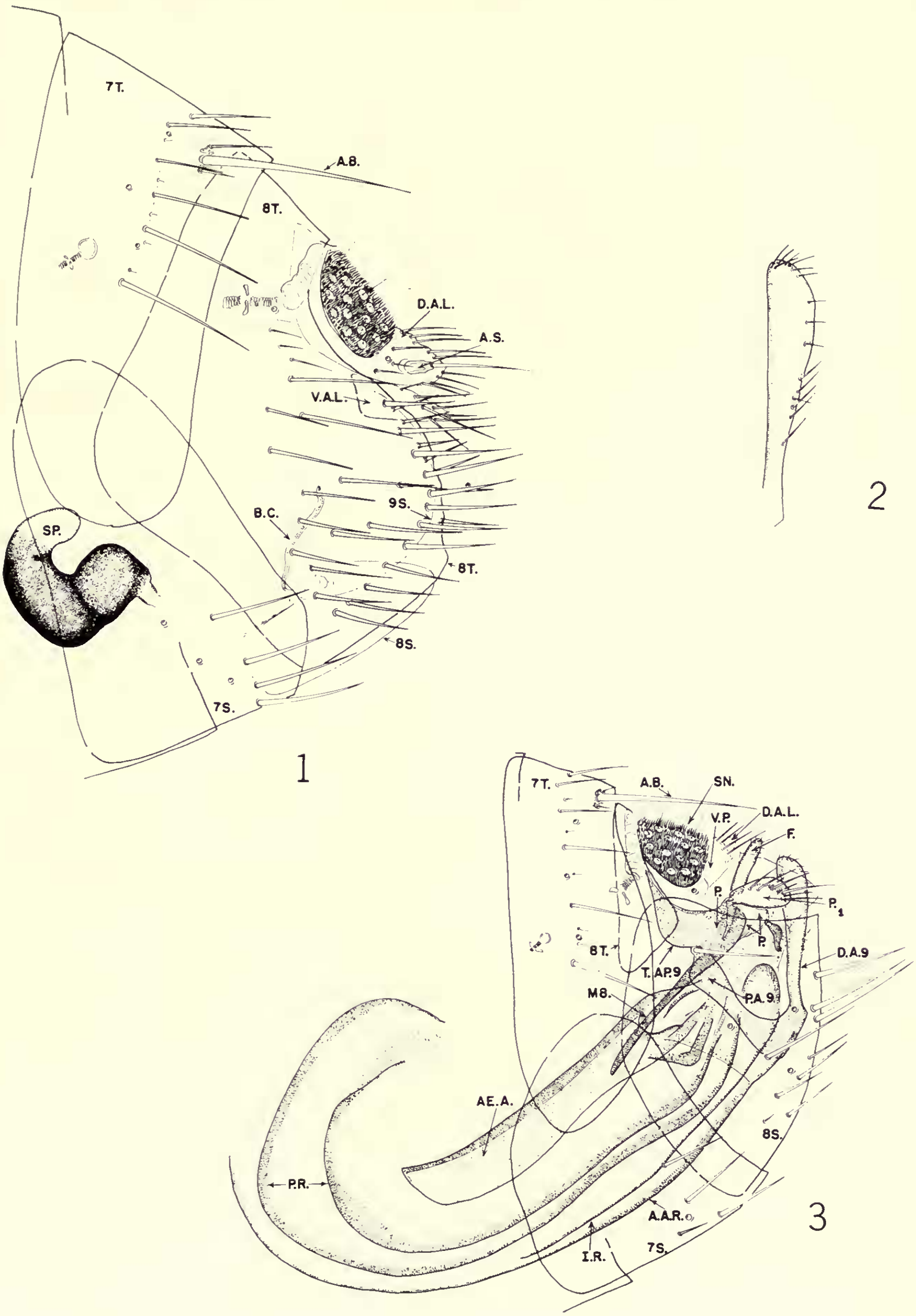
Hoplopsyllus glacialis exoticus Jordan and Rothschild, male. 1, head, prothorax and procoxa. 2, meso- and metathorax and first abdominal tergum. 3, eighth sternum. 4, process and movable finger of clasper. 5, modified abdominal segment.



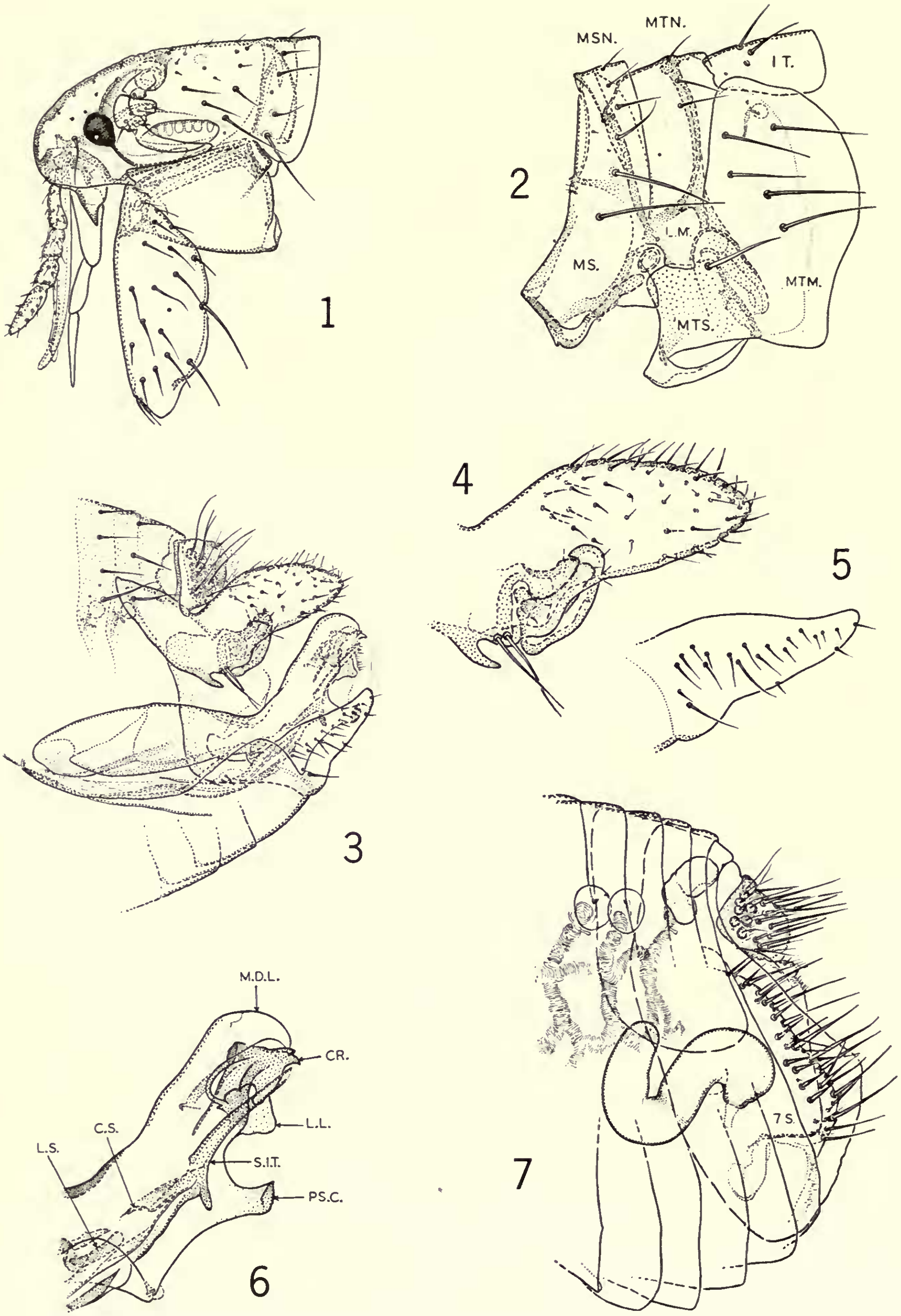
Hoplopsyllus glacialis exoticus Jordan and Rothschild. Female: 1, modified abdominal segments; 2, spermatheca; 3, anal stylet and ventral and lobe; Male: 4, distal arm of ninth sternum; 5, apex of aedeagus. *Pulex simulans* Baker, male. 6, genitalia; 7, process and movable finger of clasper.



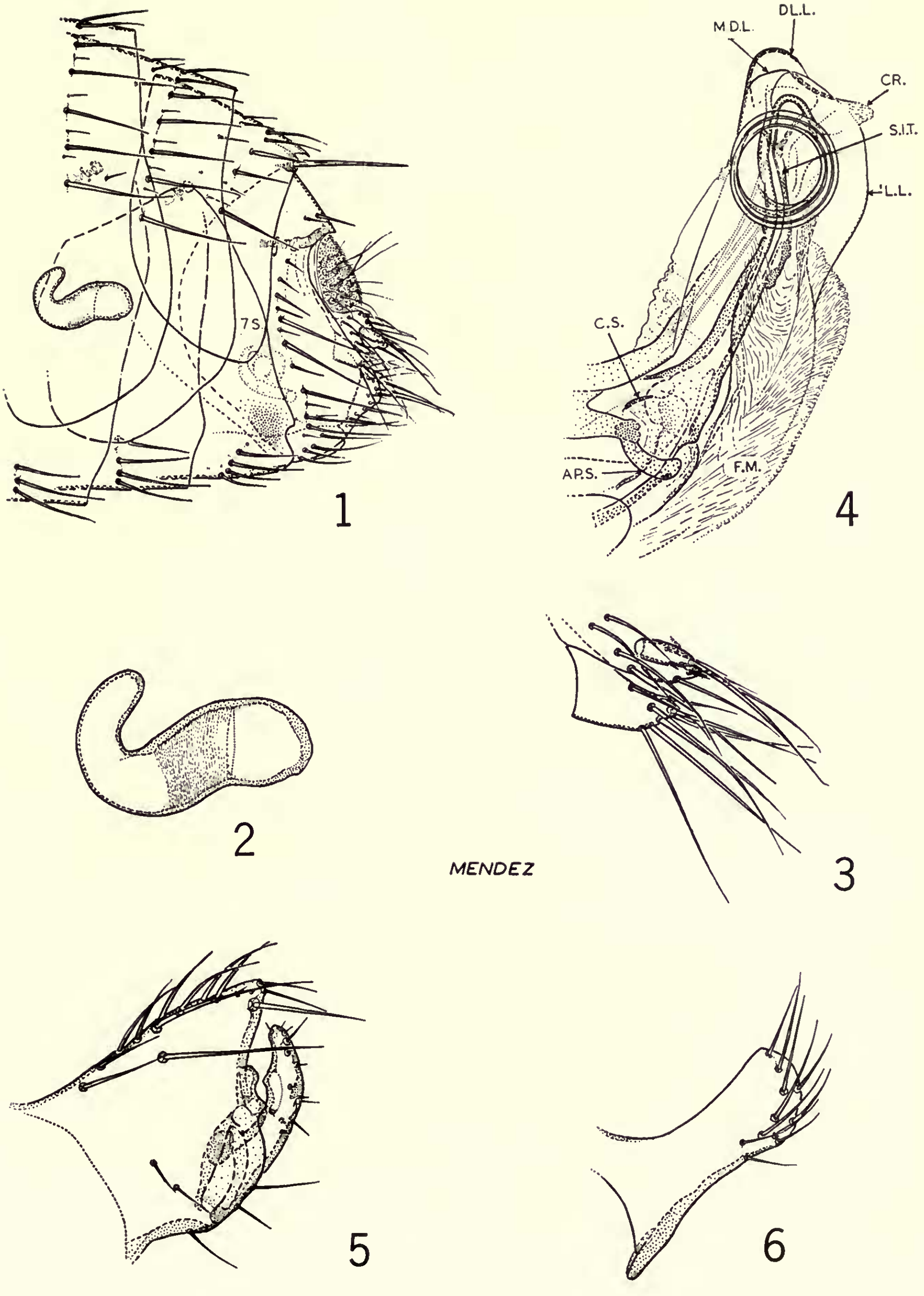
Xenopsylla cheopis Rothschild, male. 1, head, prothorax and procoxa. 2, meso- and metathorax and first abdominal tergum. 3, process and movable finger of clasper. 4, apex of aedeagus. After Johnson, 1957.



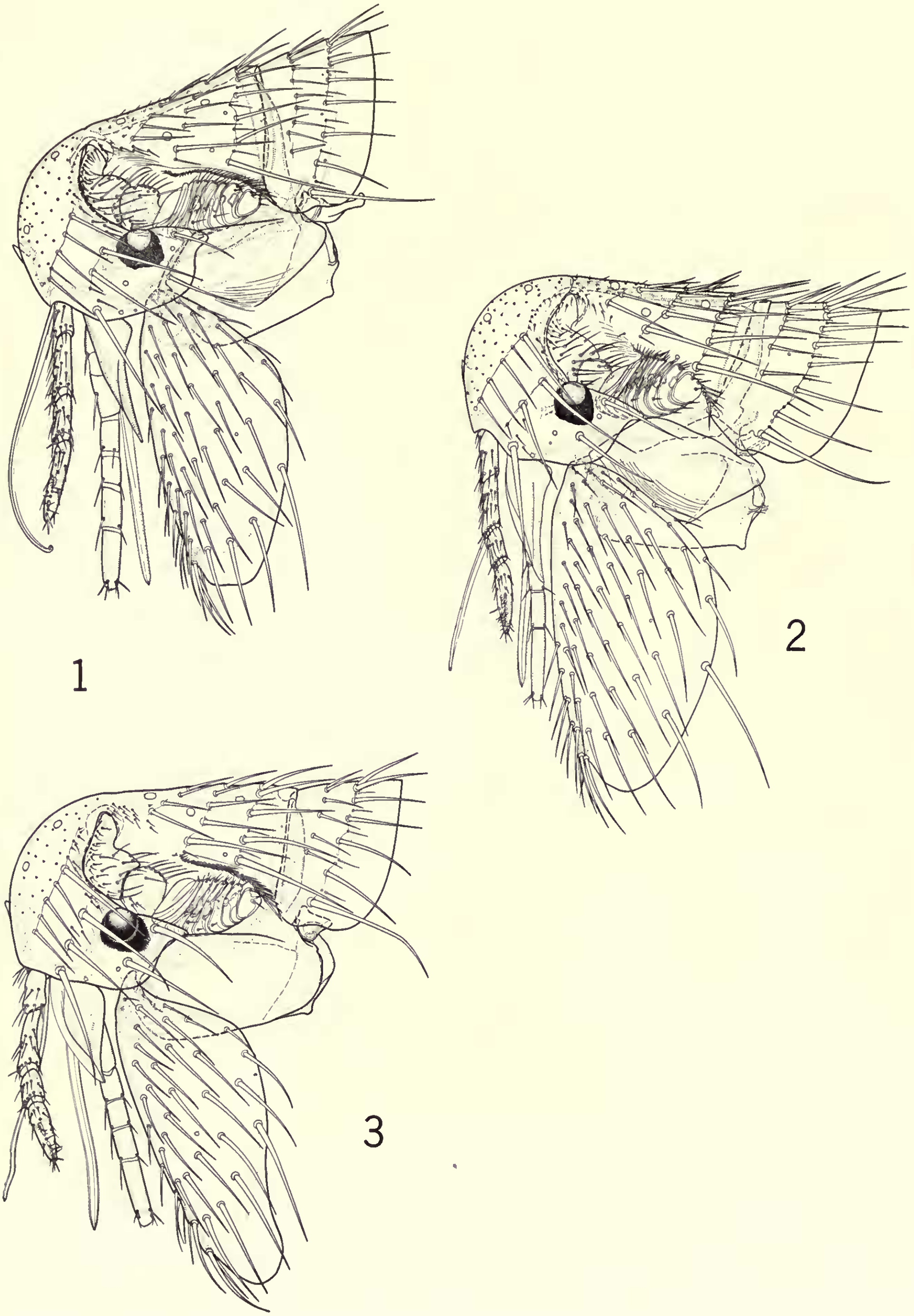
Xenopsylla cheopis Rothschild. Female: 1, modified abdominal segments. Male: 2, distal arm of ninth sternum; 3, modified abdominal segments.



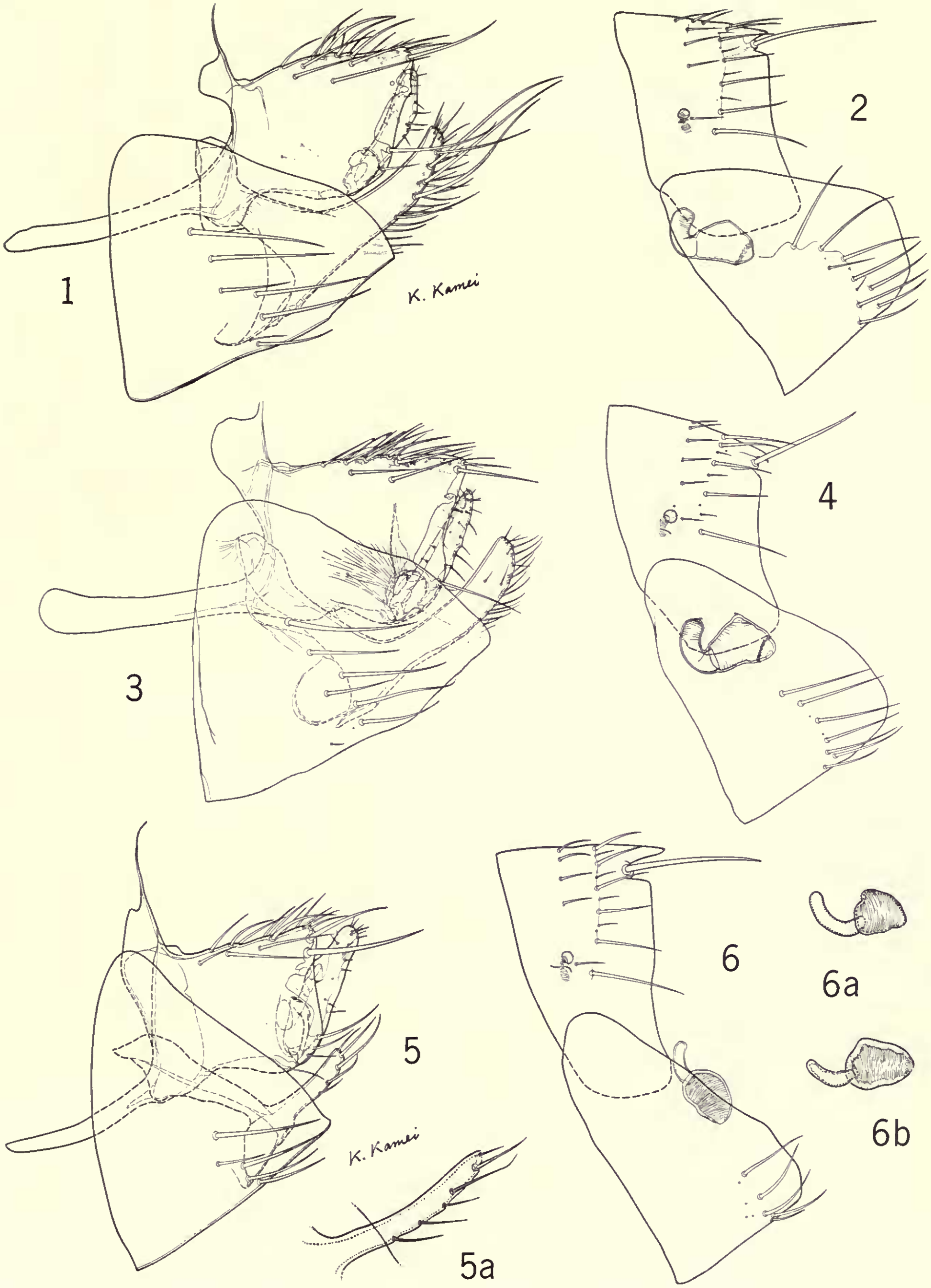
Rhynchopsyllus megastigmata Traub and Gammons. Male: 1, head, prothorax and procoxa; 2, meso- and metathorax and first abdominal tergum; 3, modified abdominal segments; 4, process and movable finger of clasper; 5, distal arm of ninth sternum; 6, apex of aedeagus. Female: 7, spermatheca and modified abdominal segments.



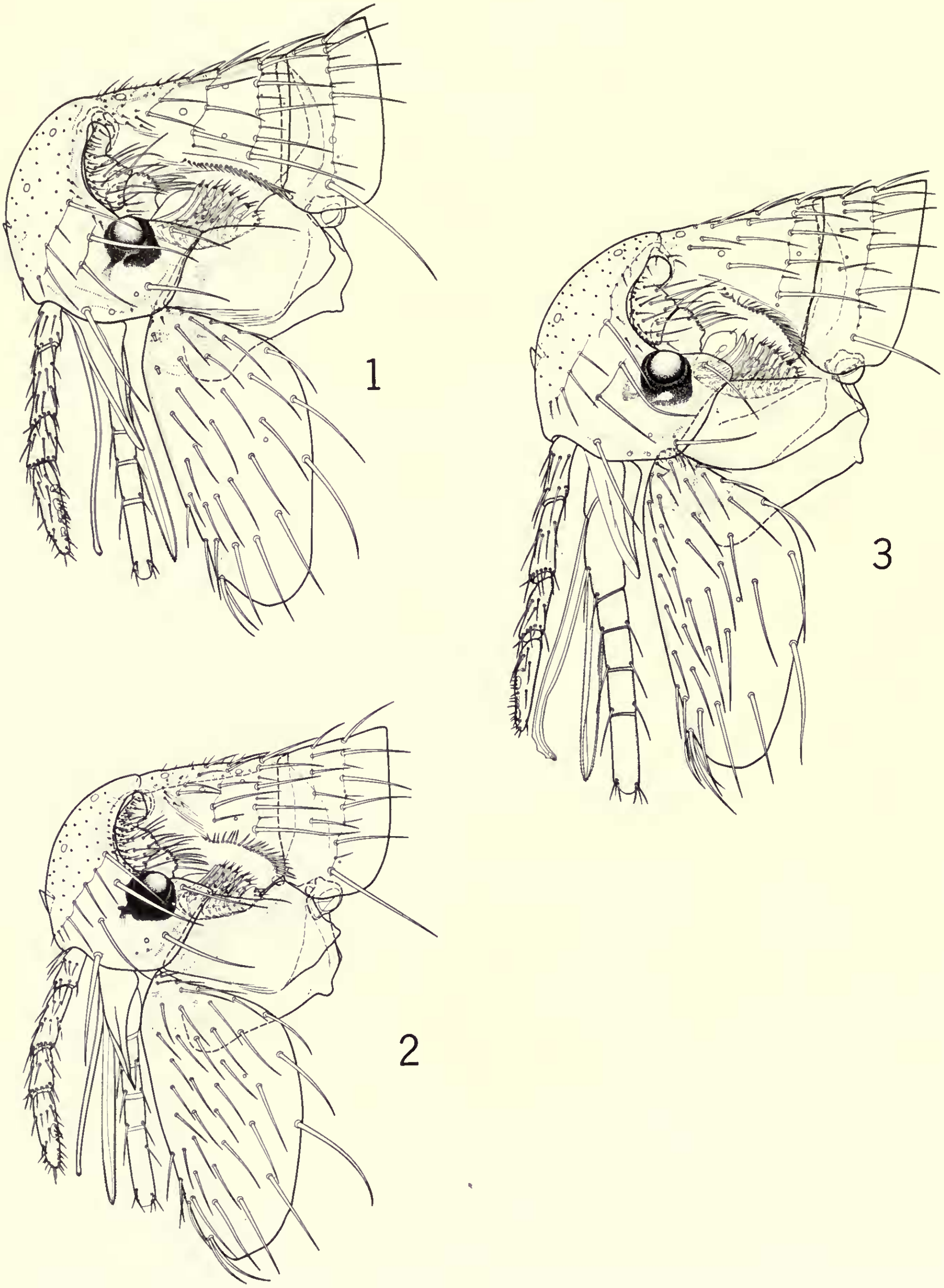
Polygenis atopus (Jordan and Rothschild). Female: 1, modified abdominal segments; 2, spermatheca; 3, anal stylet and ventral anal lobe. Male: 4, apex of aedeagus; 5, process and movable finger of clasper; 6, distal arm of ninth sternum.



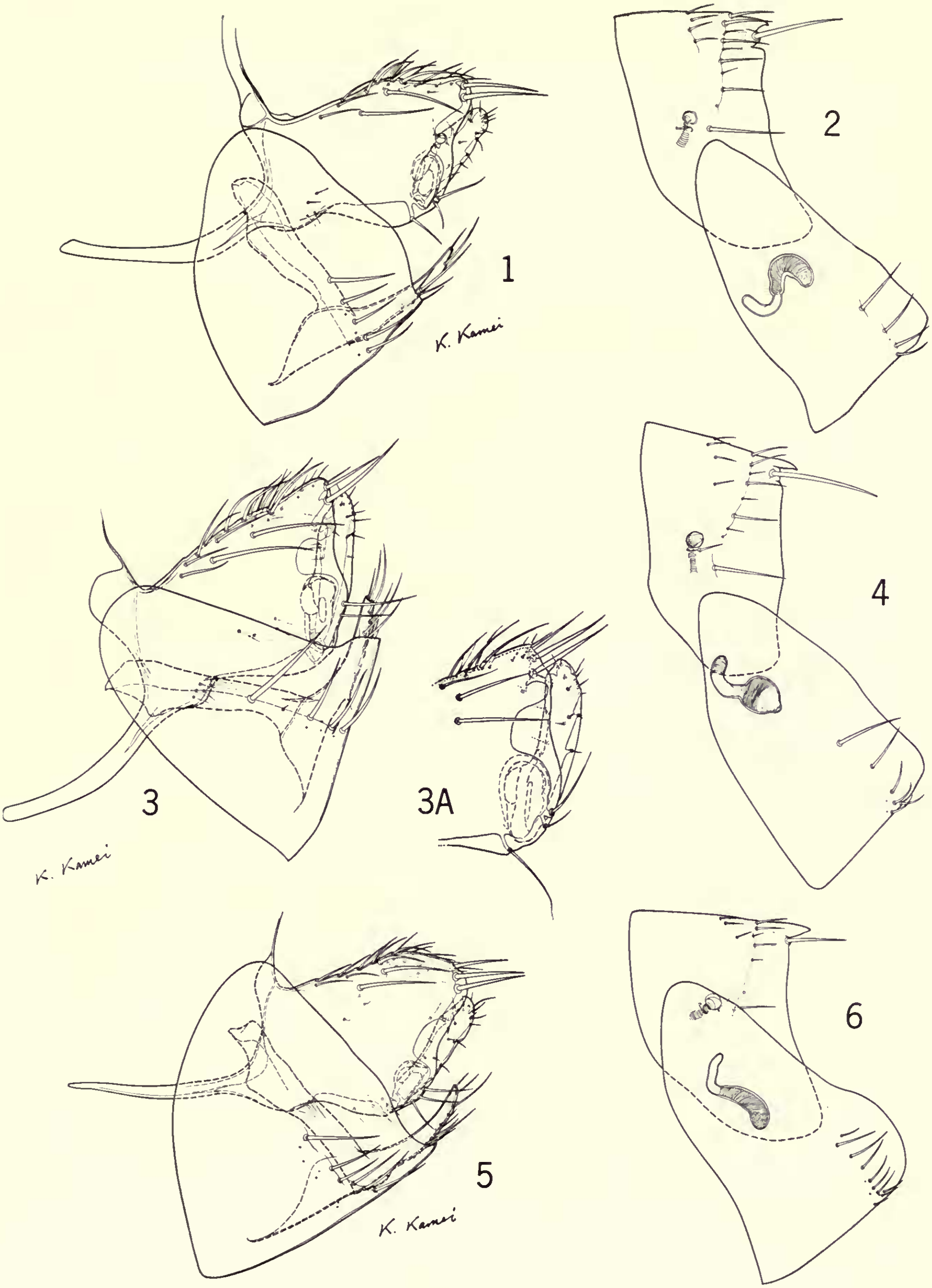
Head, prothorax and procoxa, male. 1, *Polygenis dunni* (Jordan and Rothschild). 2, *P. roberti beebei* (I. Fox). 3, *P. klagesi samuelis* (Jordan and Rothschild).



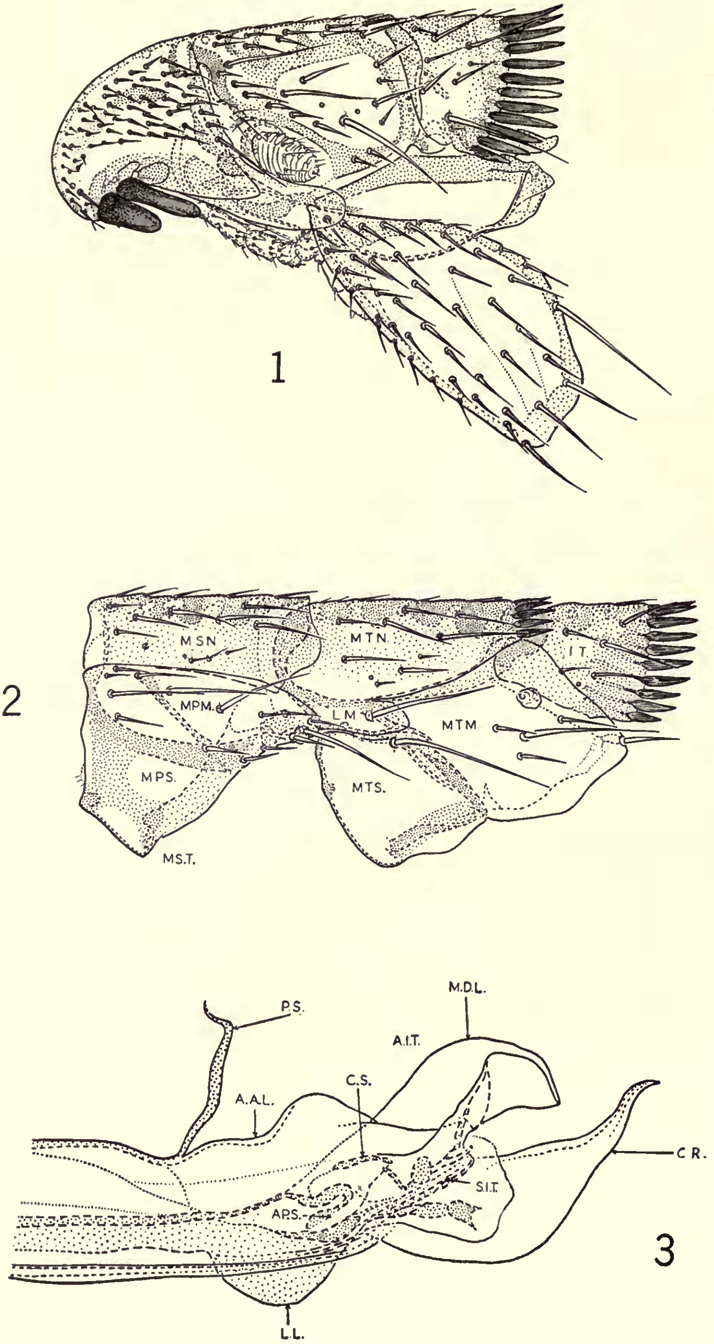
Polygenis dunni (Jordan and Rothschild). 1, male genitalia. 2, female, spermatheca and seventh abdominal segment. *P. roberti beebei* (I. Fox). 3, male genitalia. 4, female, spermatheca and seventh abdominal segment. *P. klagesi samuelis* (Jordan and Rothschild). 5, male genitalia; 5a, male, distal arm of ninth sternum of specimen from *Coendou mexicanus laenatus* showing variation. 6, female, spermatheca and seventh abdominal segment; 6a, 6b, female, spermathecae of specimens from *Coendou mexicanus laenatus* showing variation.



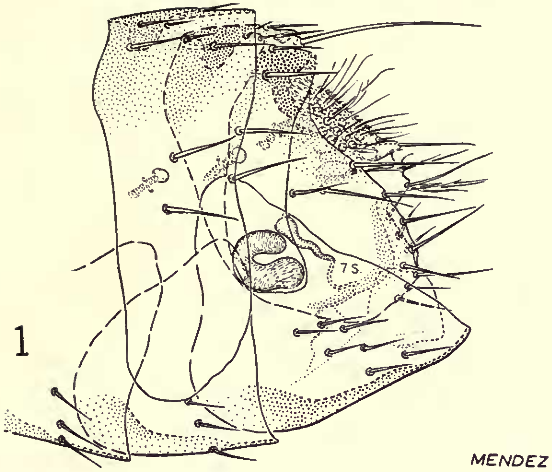
Head, prothorax and procoxa, male. 1, *Rhopalopsyllus australis tupinus* Jordan and Rothschild. 2, *R. lugubris lugubris* Jordan and Rothschild. 3, *R. cacicus saevus* Jordan and Rothschild.



Rhopalopsyllus australis tupinus Jordan and Rothschild. 1, male genitalia. 2, female, spermatheca and seventh abdominal segment. *R. lugubris lugubris* Jordan and Rothschild. 3, male genitalia. 4, female, spermatheca and seventh abdominal segment. *R. lugubris cryptoctenes* (Enderlein). 3a, male, process and movable finger of clasper. *R. cacicus saevus* Jordan and Rothschild. 5, male genitalia. 6, female, spermatheca and seventh abdominal segment.



Hormopsylla kyriophila, new species, male. 1, head prothorax and procoxa. 2, meso- and metathorax and first abdominal tergum. 3, apex of aedeagus.



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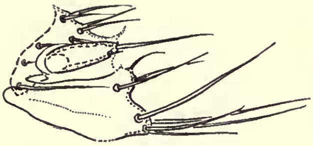

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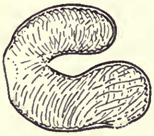

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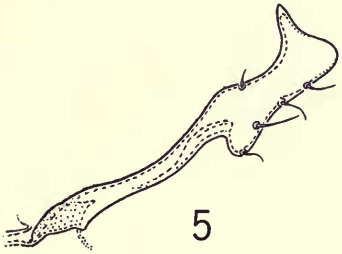

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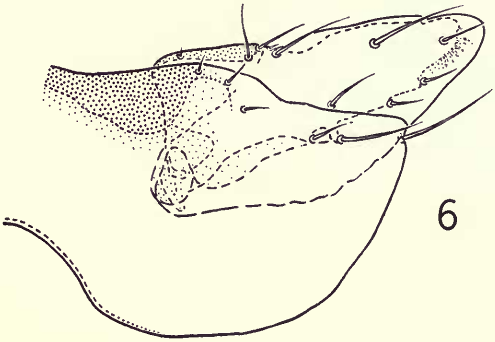

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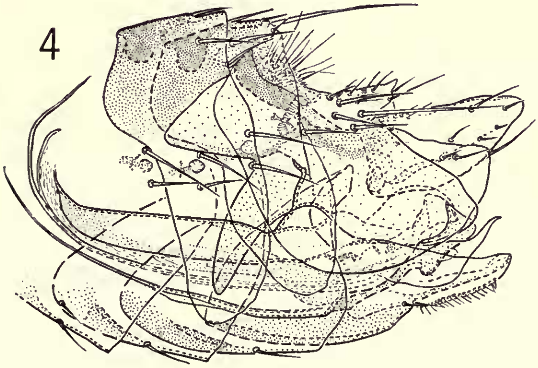

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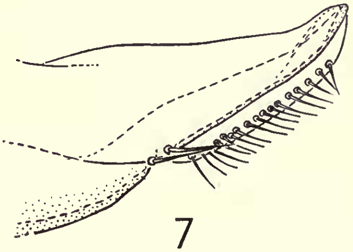
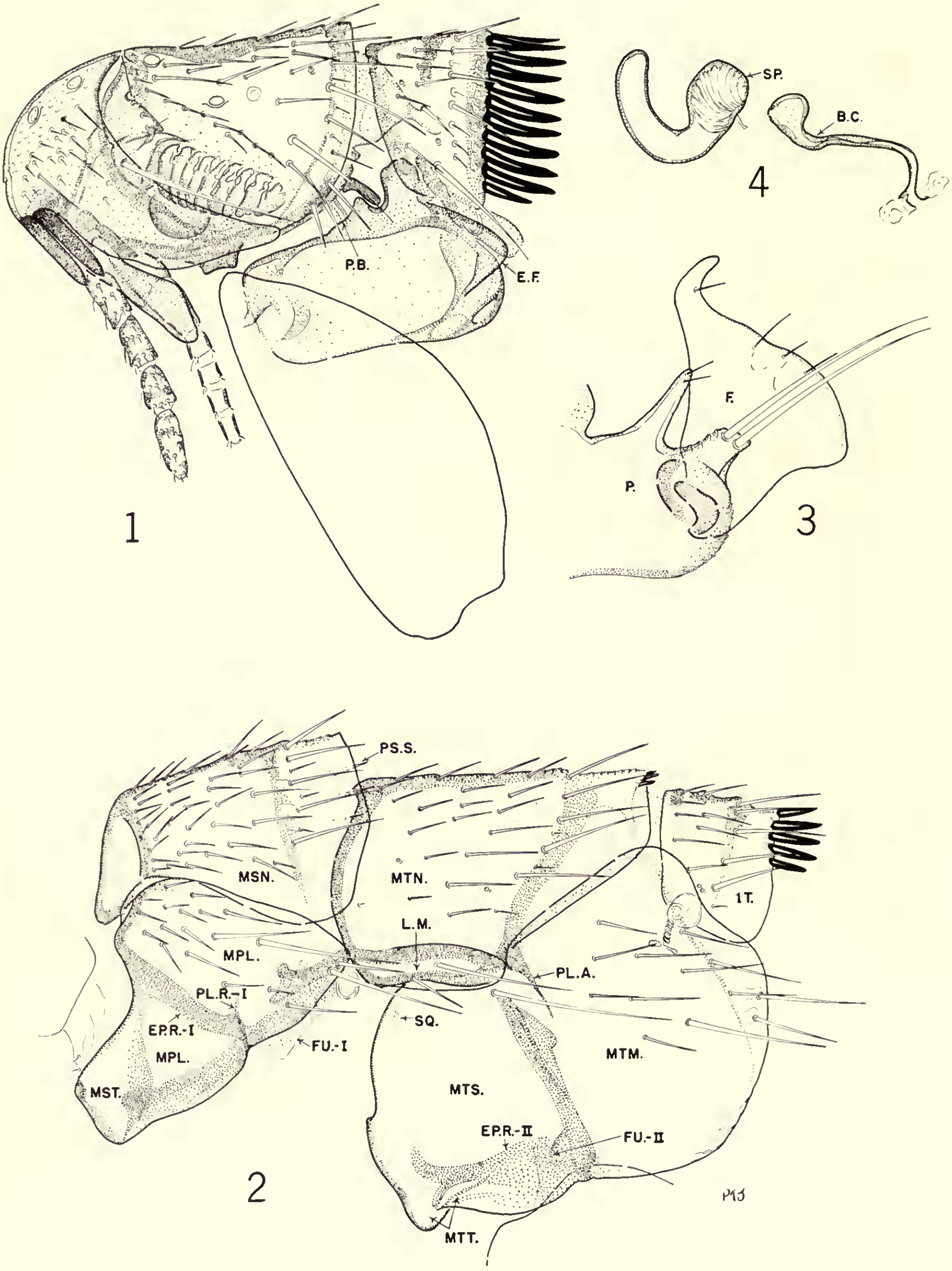
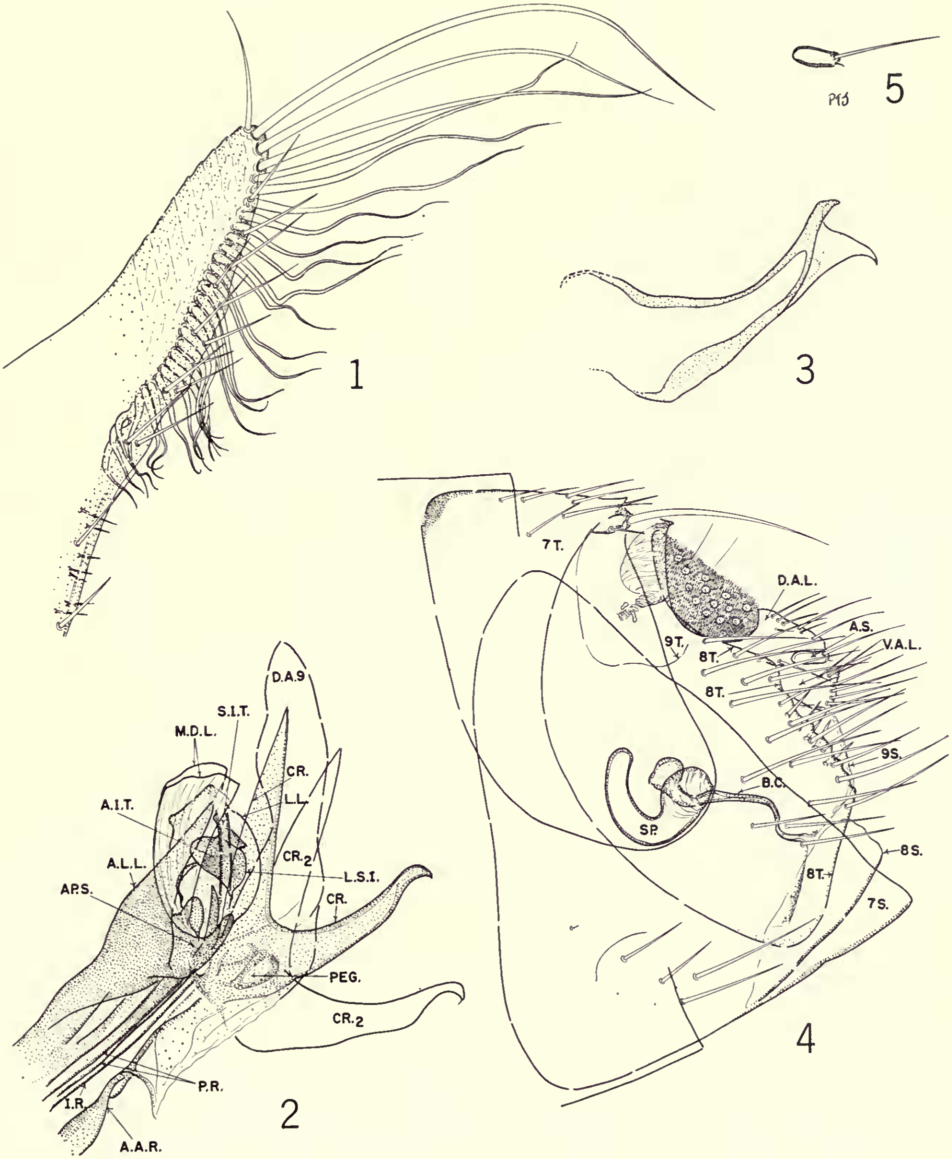


7

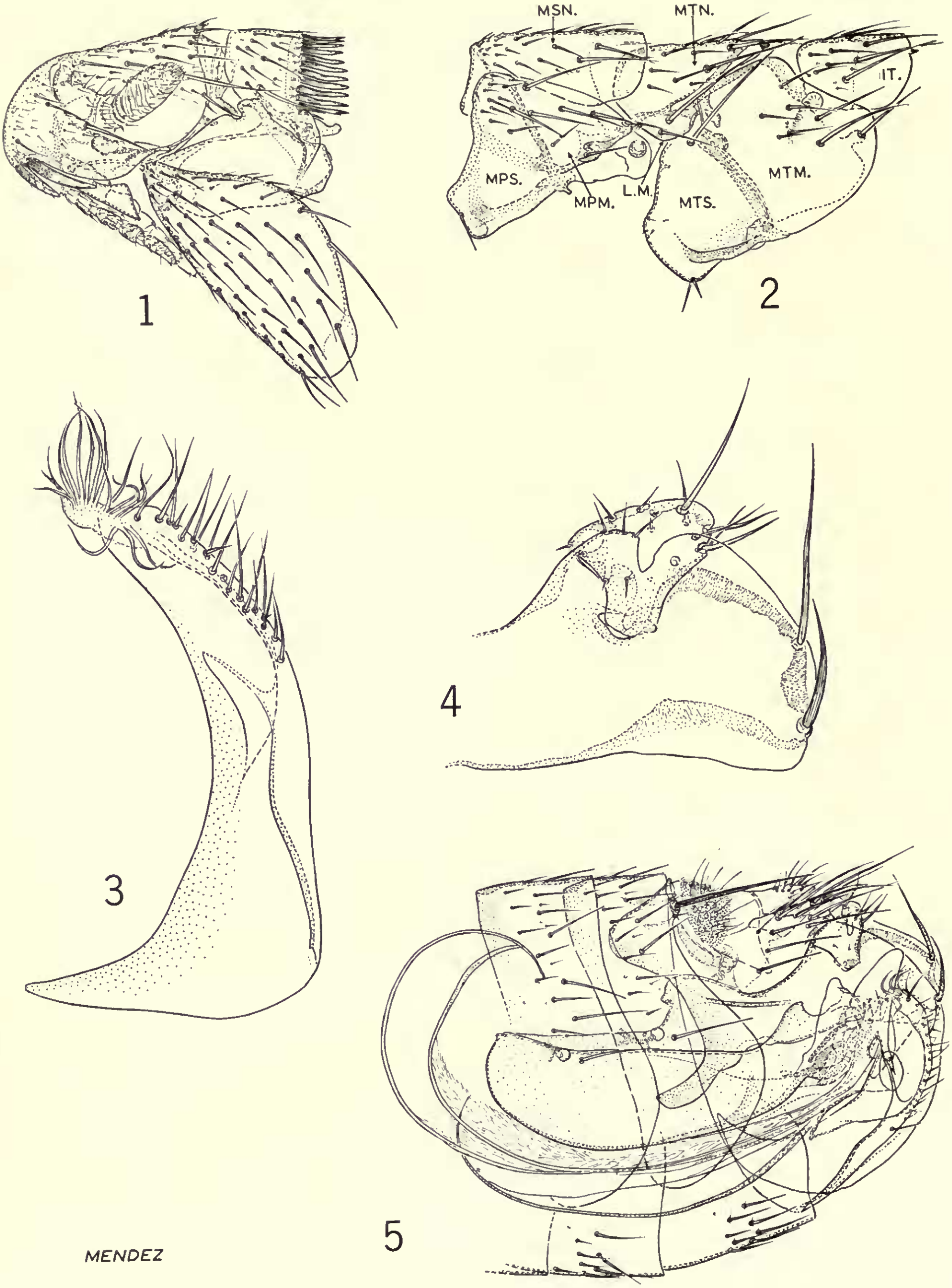
Hormopsylla kyriophila, new species. Female: 1, modified abdominal segments; 2, anal stylet and ventral anal lobe; 3, spermatheca. Male: 4, modified abdominal segments; 5, distal arm of ninth sternum; 6, process and movable finger of clasper; 7, eighth sternum.



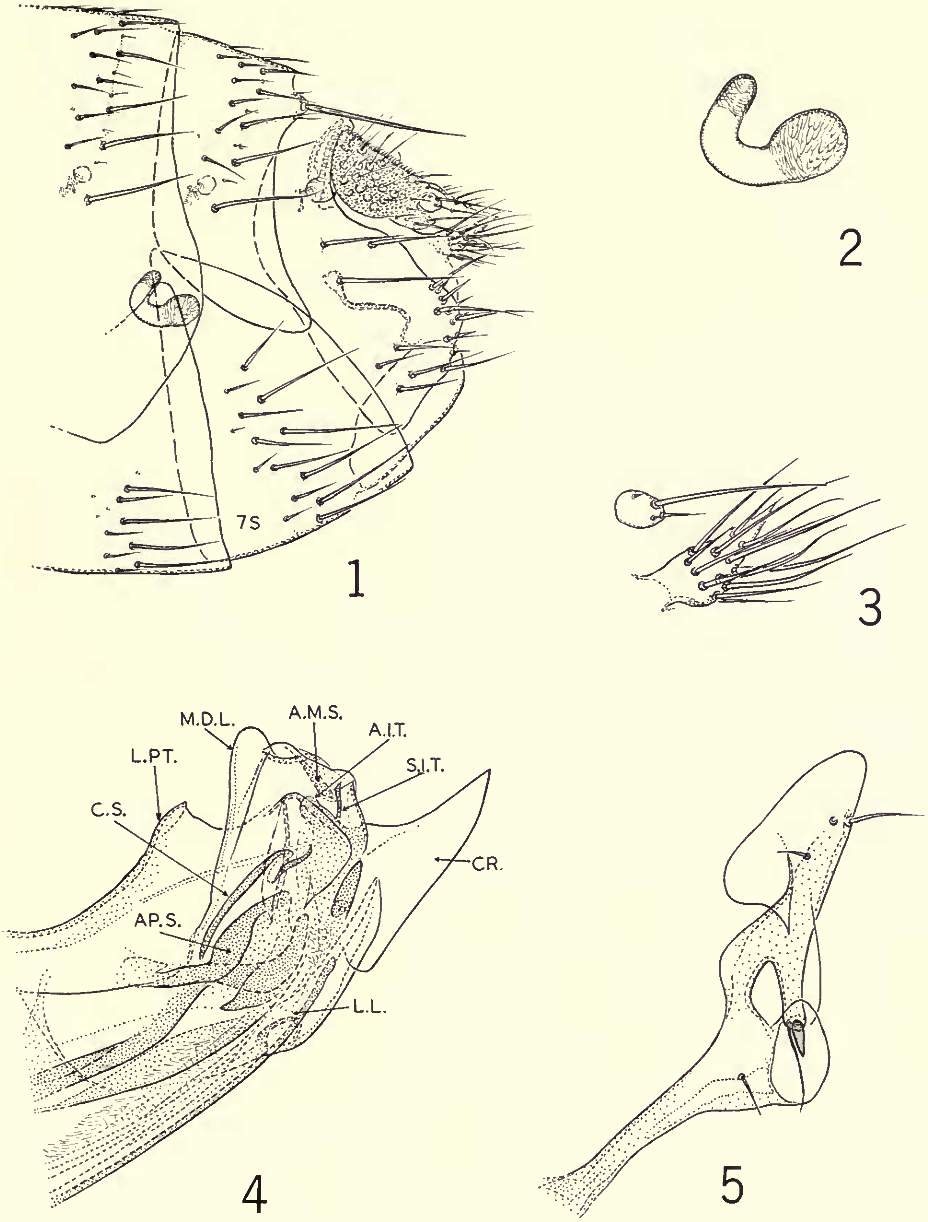
Ptilopsylla dunni Kohls. Male: 1, head, prothorax and procoxa; 2, meso- and metathorax and first abdominal tergum; 3, process and movable finger of clasper. Female: 4, spermatheca and bursa copulatrix. After Johnson (1957).



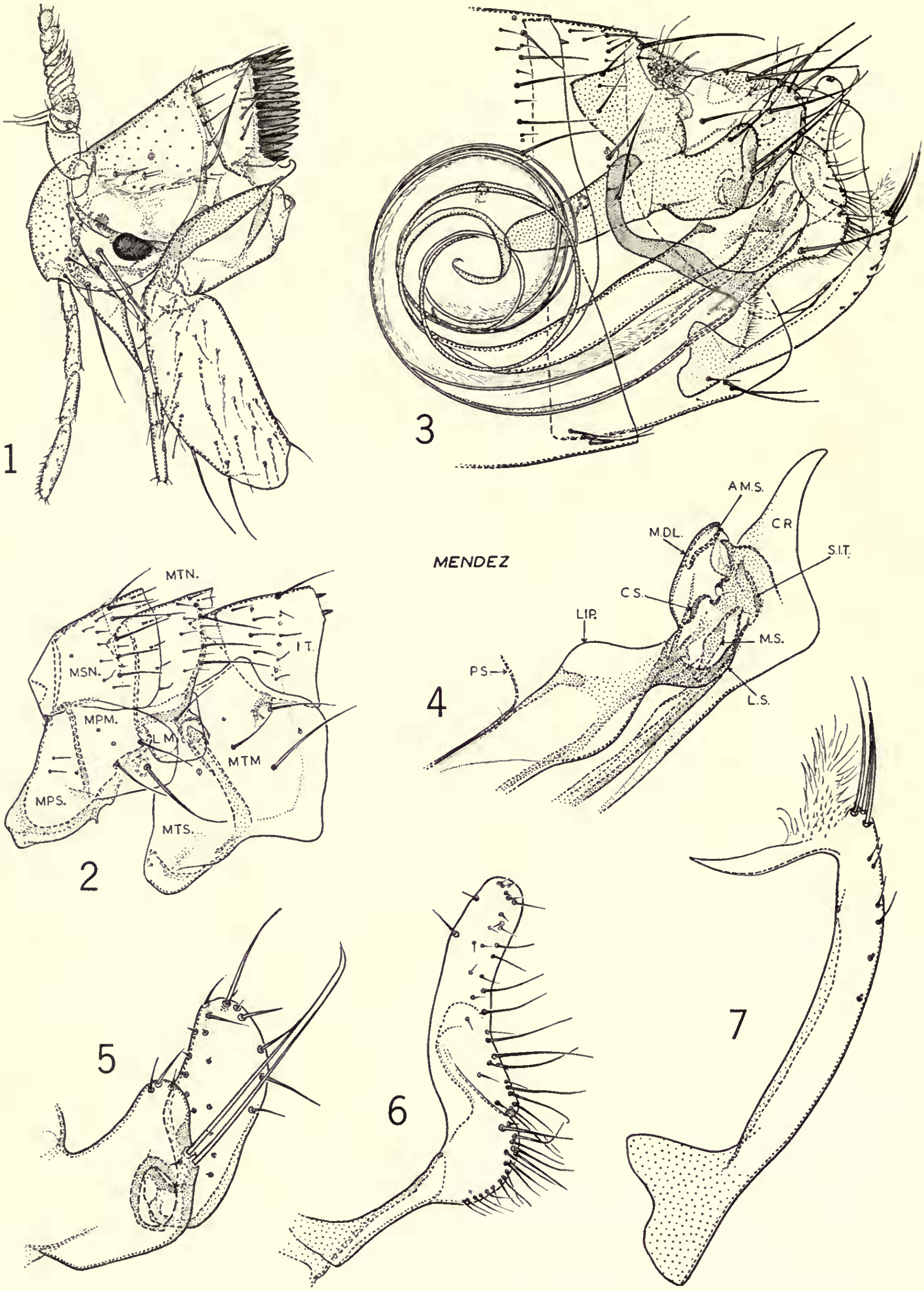
Ptilopsylla dunni Kohls. Male: 1, eighth sternum; 2, apex of aedeagus; 3, crochet. Female: 4, modified abdominal segments; 5, anal stylet. After Johnson (1957), except fig. 3.



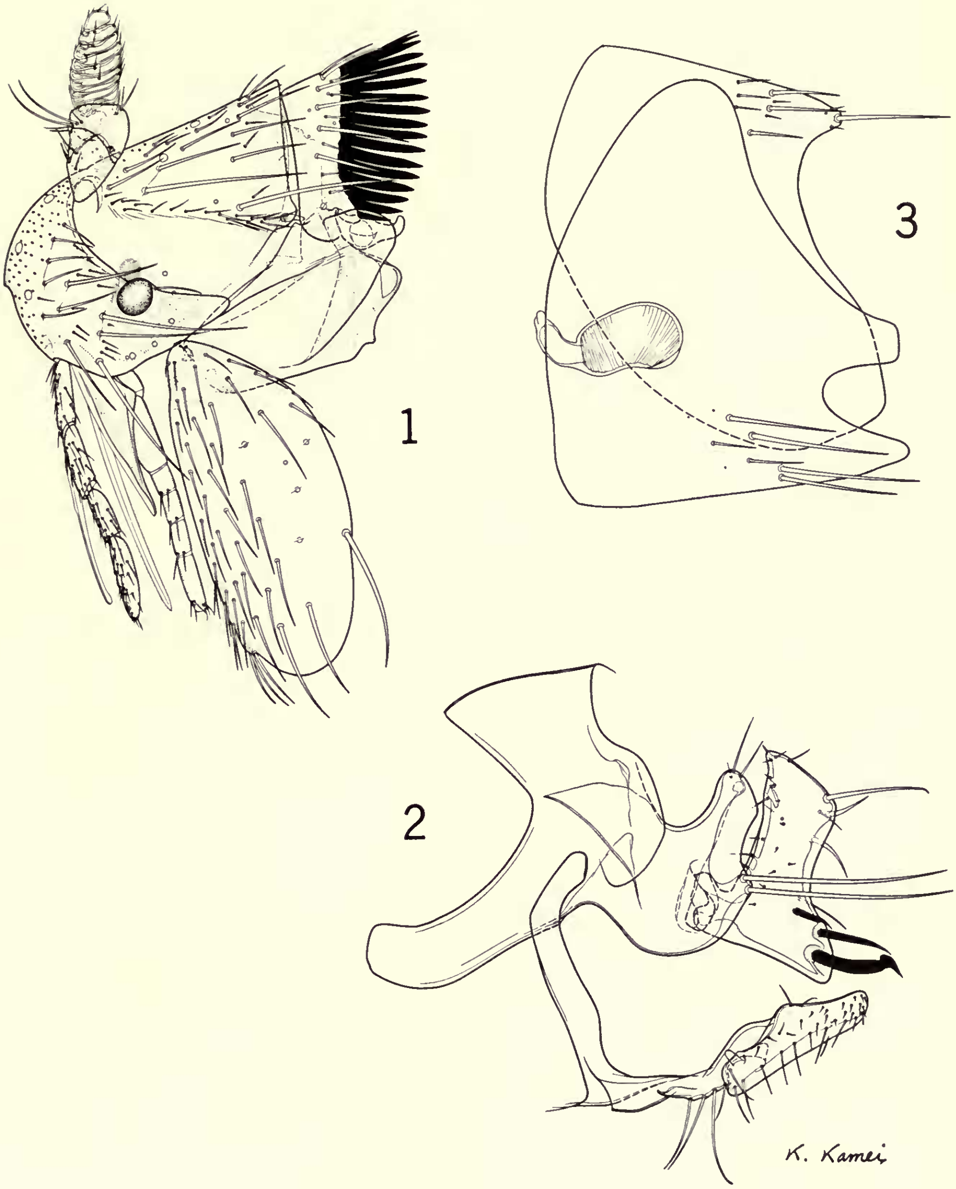
Sternopsylla distincta speciosa Johnson, male. 1, head, prothorax and procoxa. 2, meso- and metathorax and first abdominal tergum. 3, eighth sternum. 4, process and movable finger of clasper. 5, modified abdominal segments.



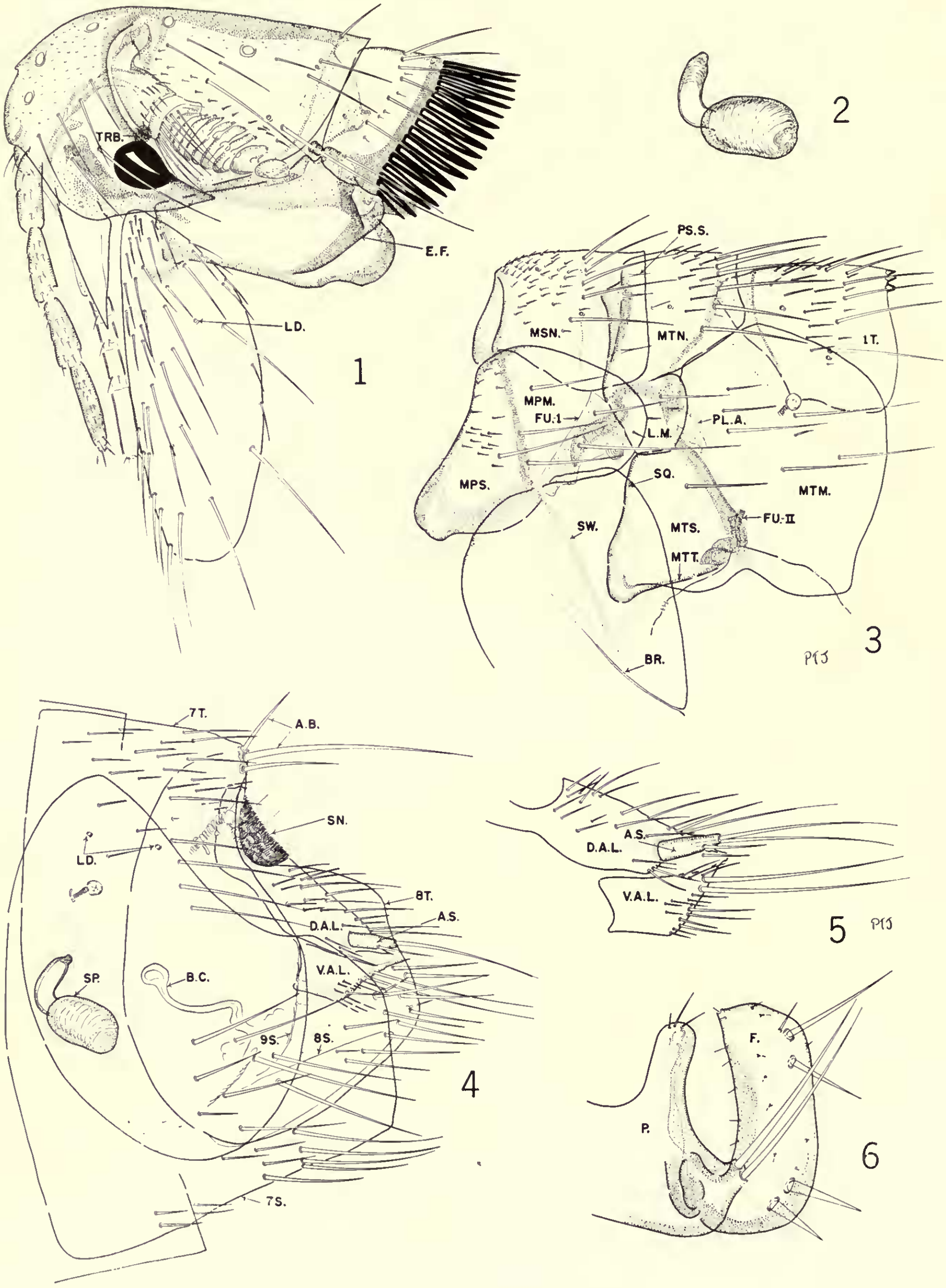
Sternopsylla distincta speciosa Johnson. Female: 1, modified abdominal segments; 2, spermatheca; 3, anal stylet and ventral anal lobe. Male: 4, apex of aedeagus; 5, distal arm of ninth sternum.



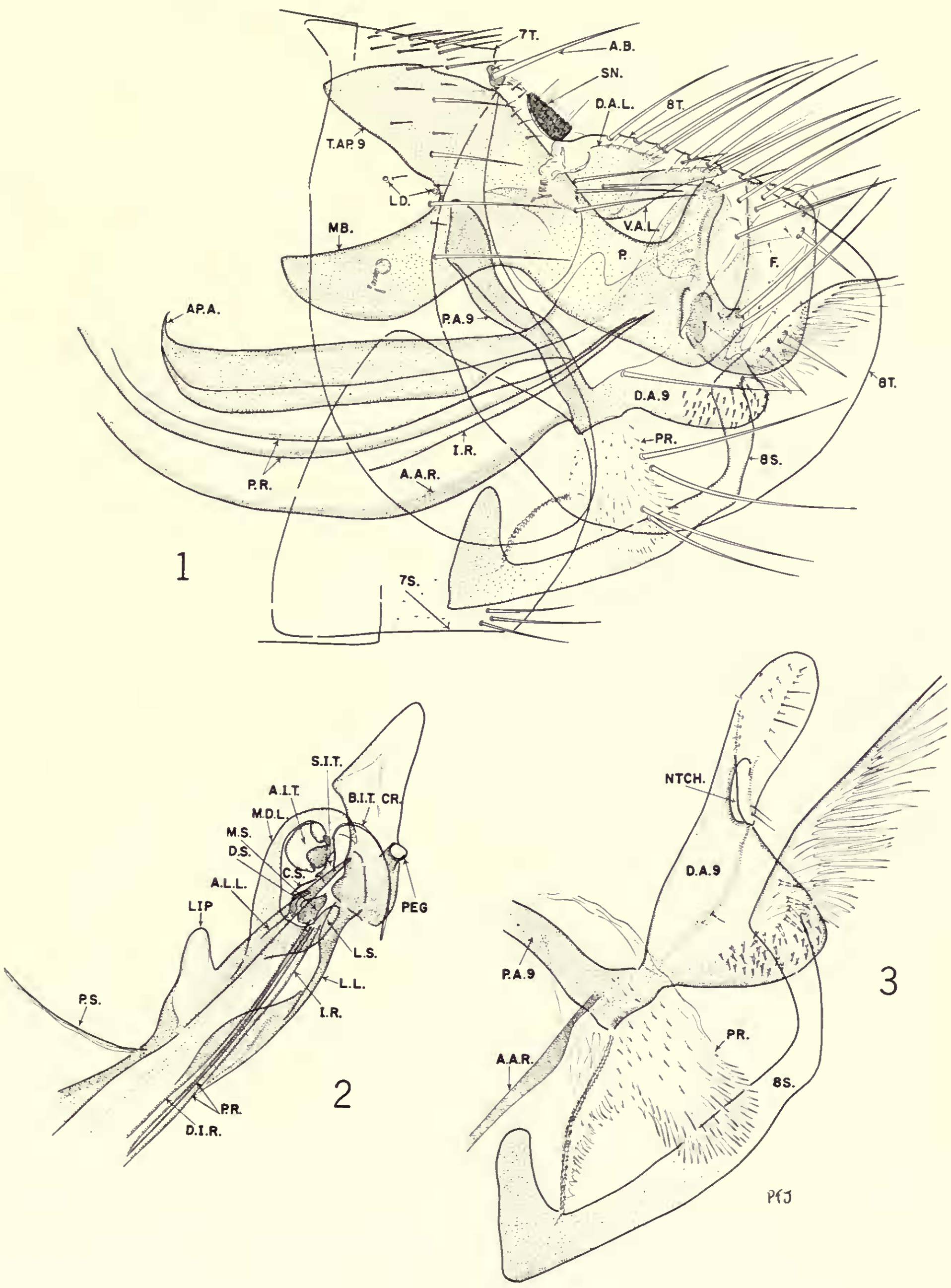
Ceratophyllus altus, new species, male. 1, head, prothorax and procoxa. 2, meso- and metathorax and first abdominal tergum. 3, modified abdominal segments. 4, apex of aedeagus. 5, process and movable finger of clasper. 6, distal arm of ninth sternum. 7, eighth sternum.



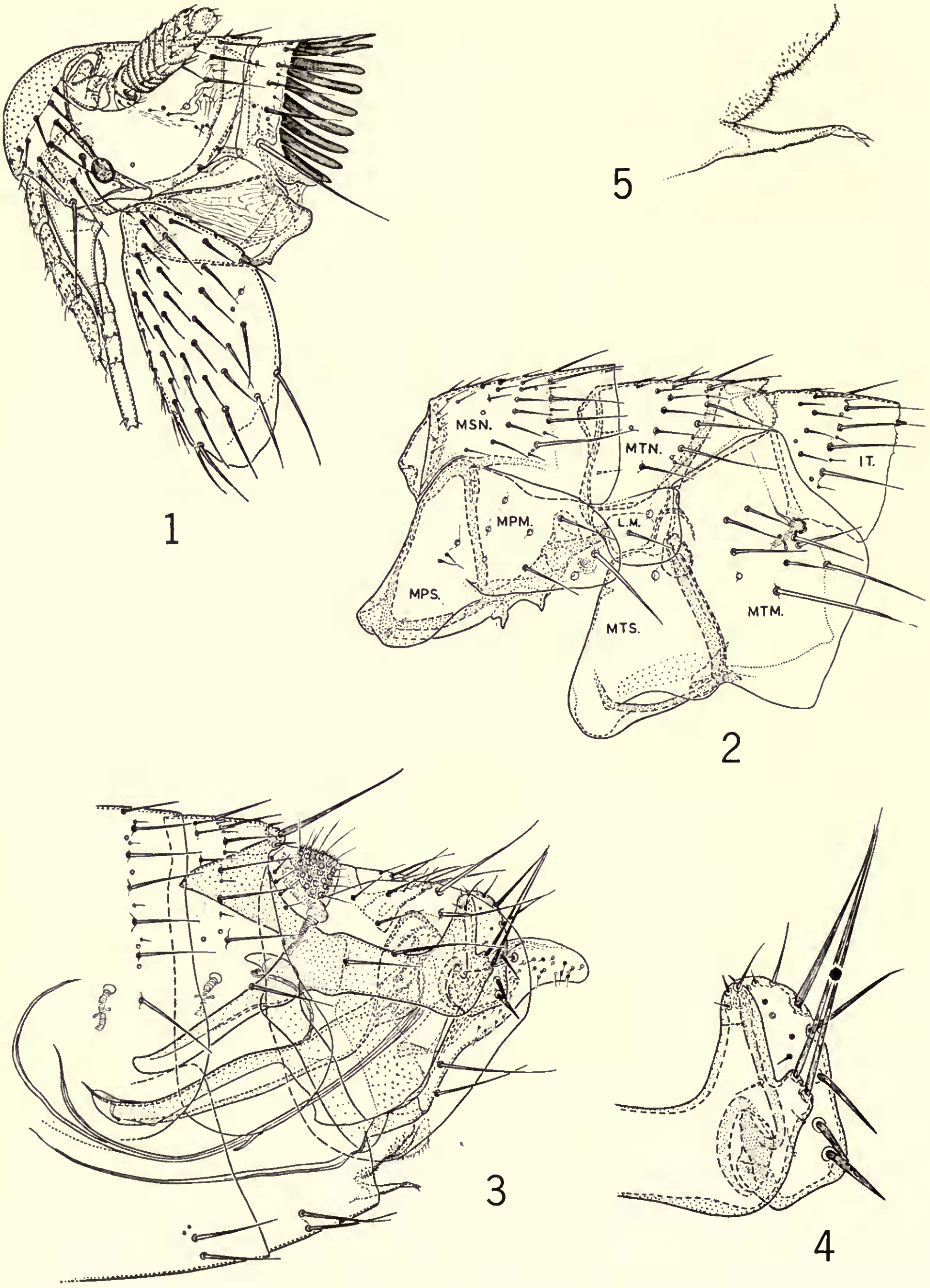
Dasypsyllus gallinulae perpinnatus (Baker). Male: 1, head, prothorax and procoxa; 2, genitalia. Female: 3, spermatheca and seventh abdominal segment.



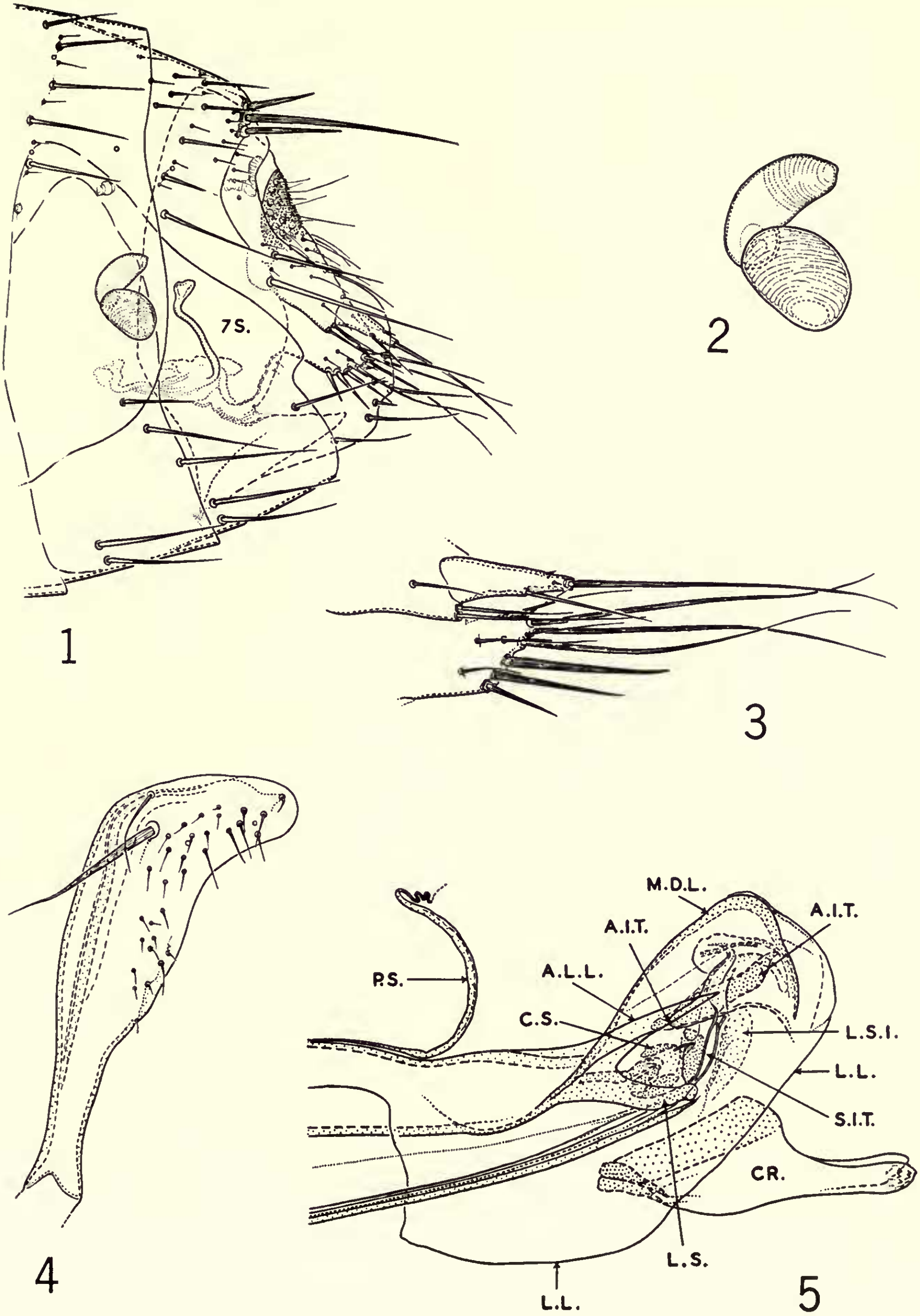
Dasypsyllus lasius venezuelensis (I. Fox and Anduze). 1, male, head, prothorax and procoxa. 2, female, spermatheca; 3, male, meso- and metathorax and first abdominal tergum. 4, female, modified abdominal segments. 5, female, anal stylet, dorsal and ventral anal lobes. 6, male, process and movable finger of clasper. After Johnson (1957).



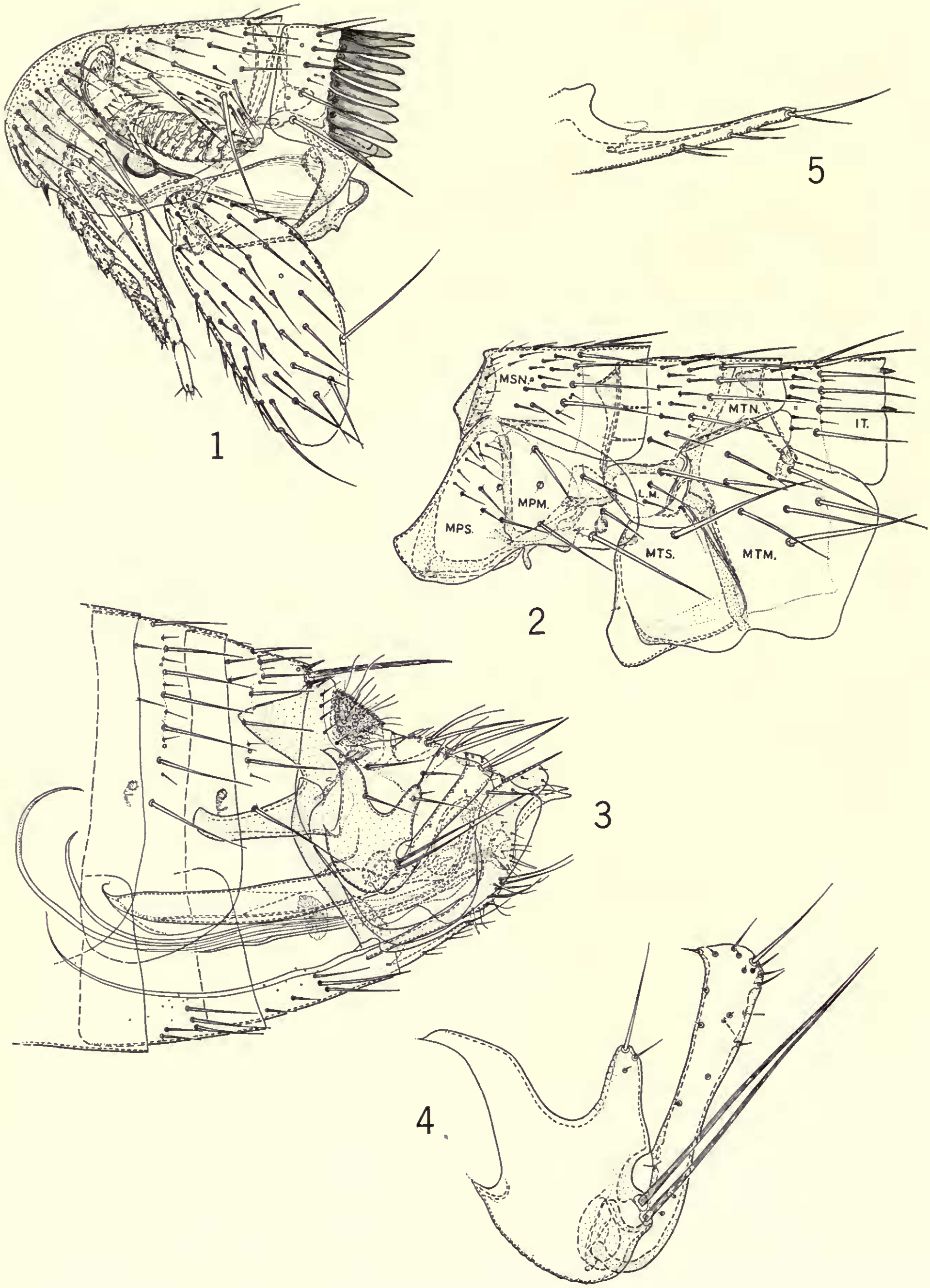
Dasypsyllus lasius venezuelensis (I. Fox and Anduze), male. 1, modified abdominal segments. 2, apex of aedeagus. 3, eighth sternum and distal arm of ninth sternum. After Johnson, 1957.



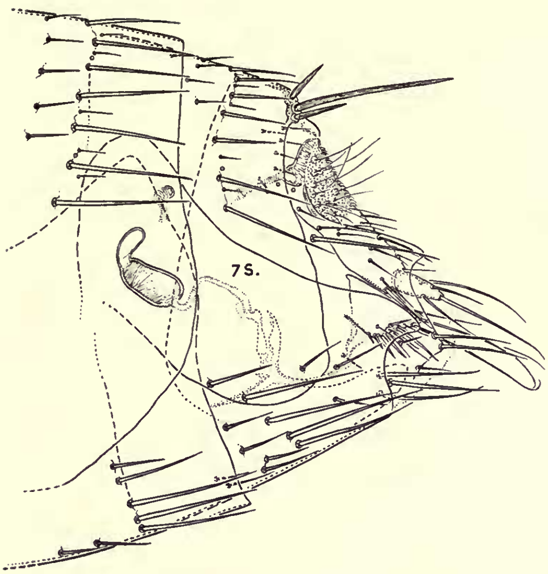
Jellisonia johnsonae Tipton and Mendez, male. 1, head, prothorax and procoxa. 2, meso- and metathorax and first abdominal tergum. 3, modified abdominal segment. 4, process and movable finger of clasper. 5, eighth sternum.



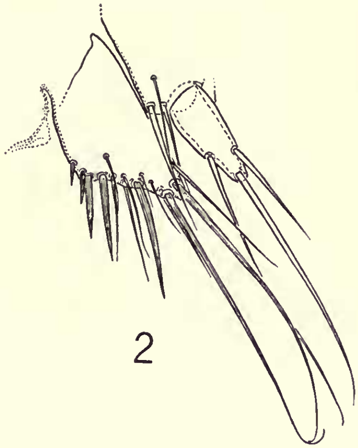
Jellisonia johnsonae Tipton and Mendez. Female: 1, modified abdominal segments; 2, spermatheca; 3, anal stylet and ventral anal lobe. Male: 4, distal arm of ninth sternum. 5, apex of aedeagus.



Pleochaetis altmani Tipton and Mendez, male. 1, head, prothorax and procoxa. 2, meso- and metathorax and first abdominal tergum. 3, modified abdominal segments. 4, process and movable finger of clasper. 5, eighth sternum.



1



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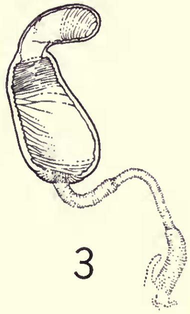

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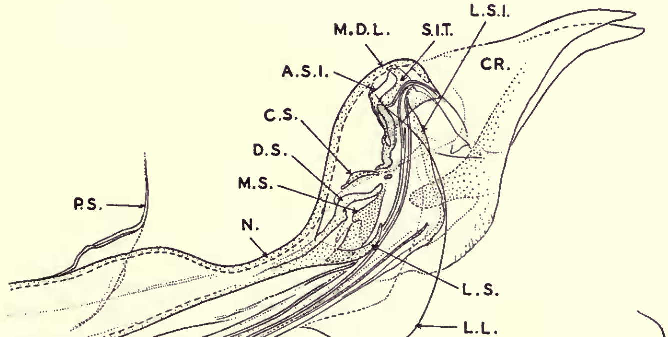
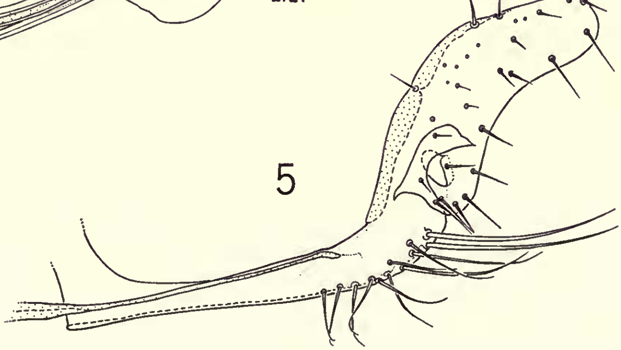
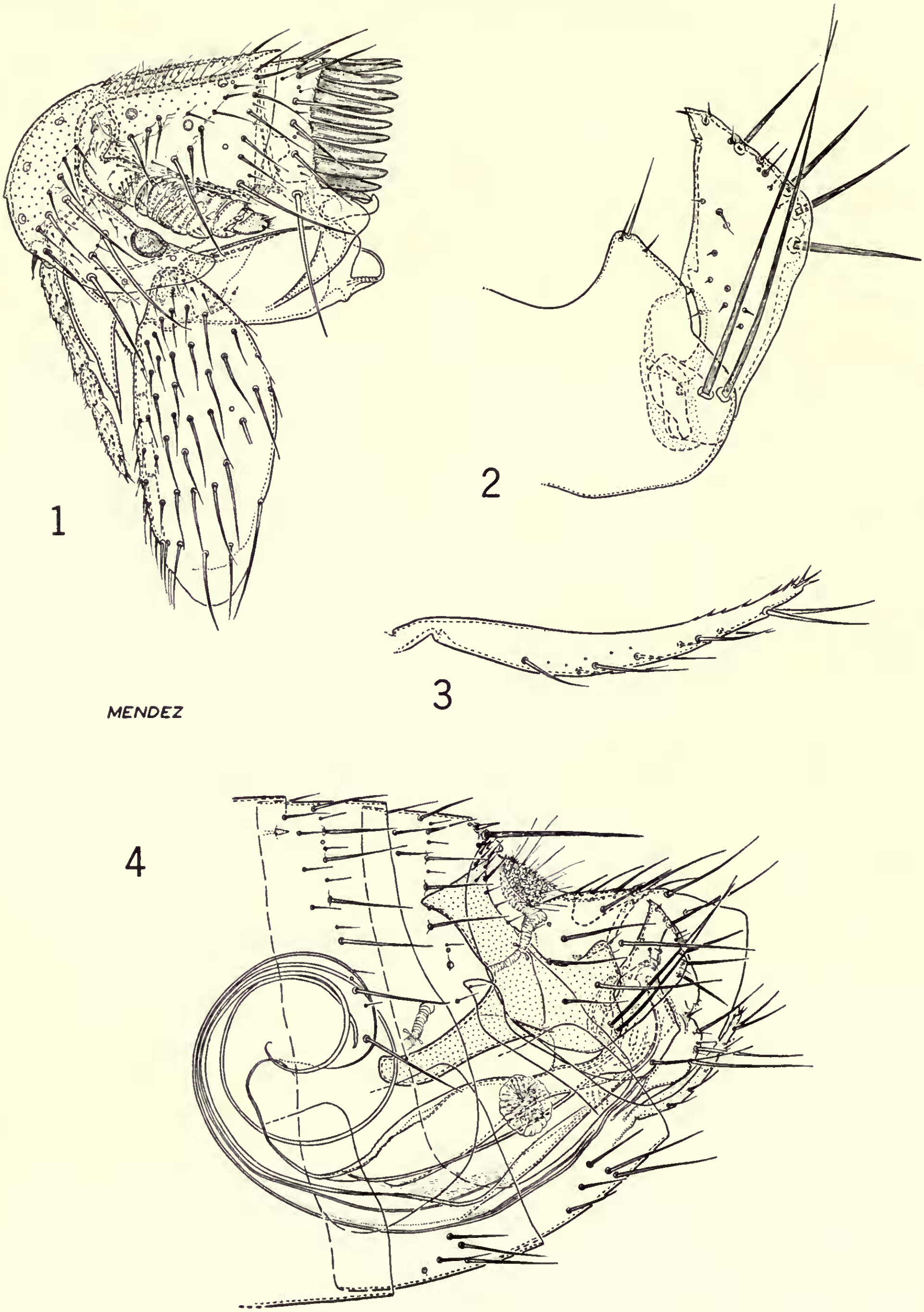


4

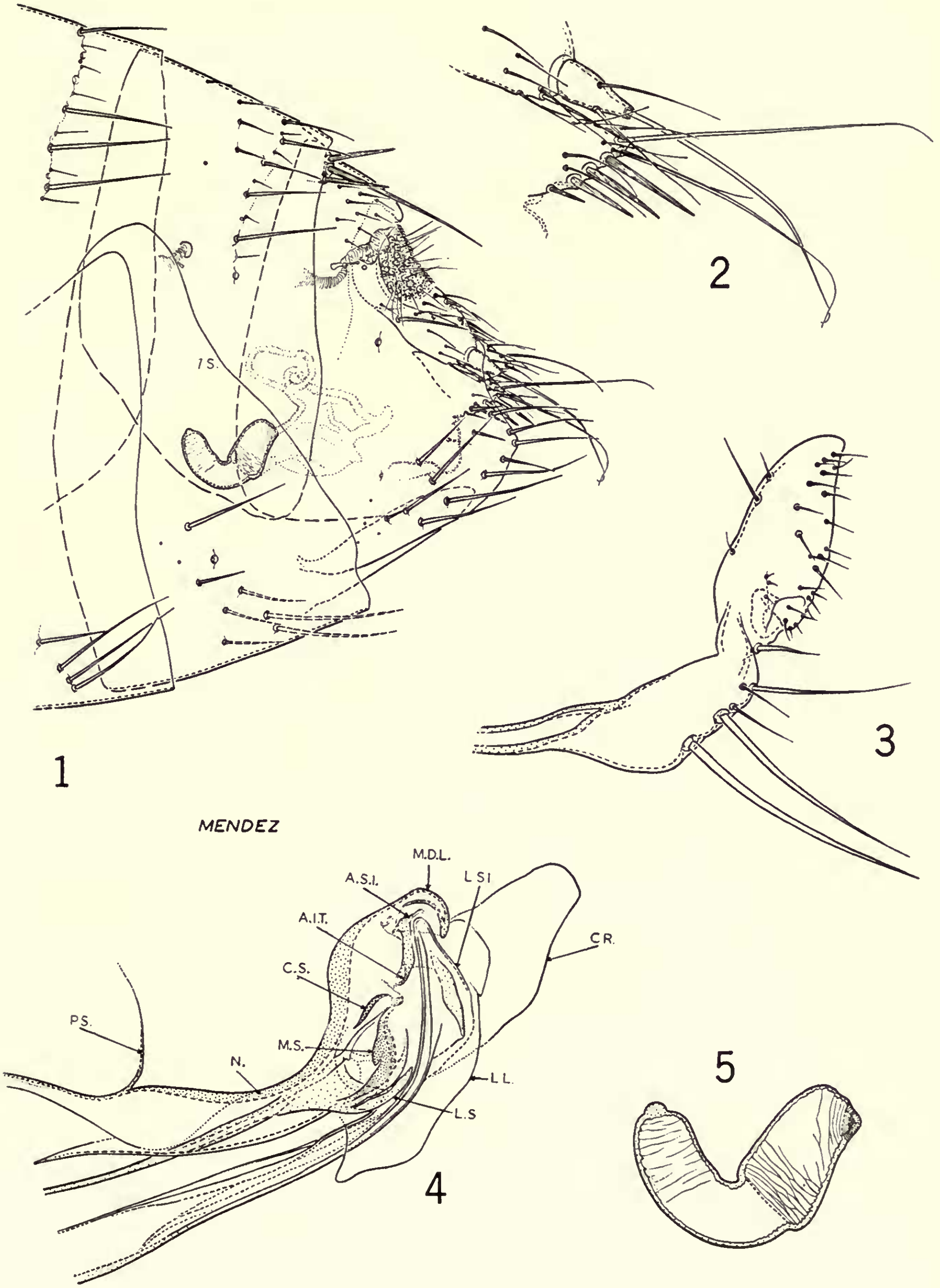


5

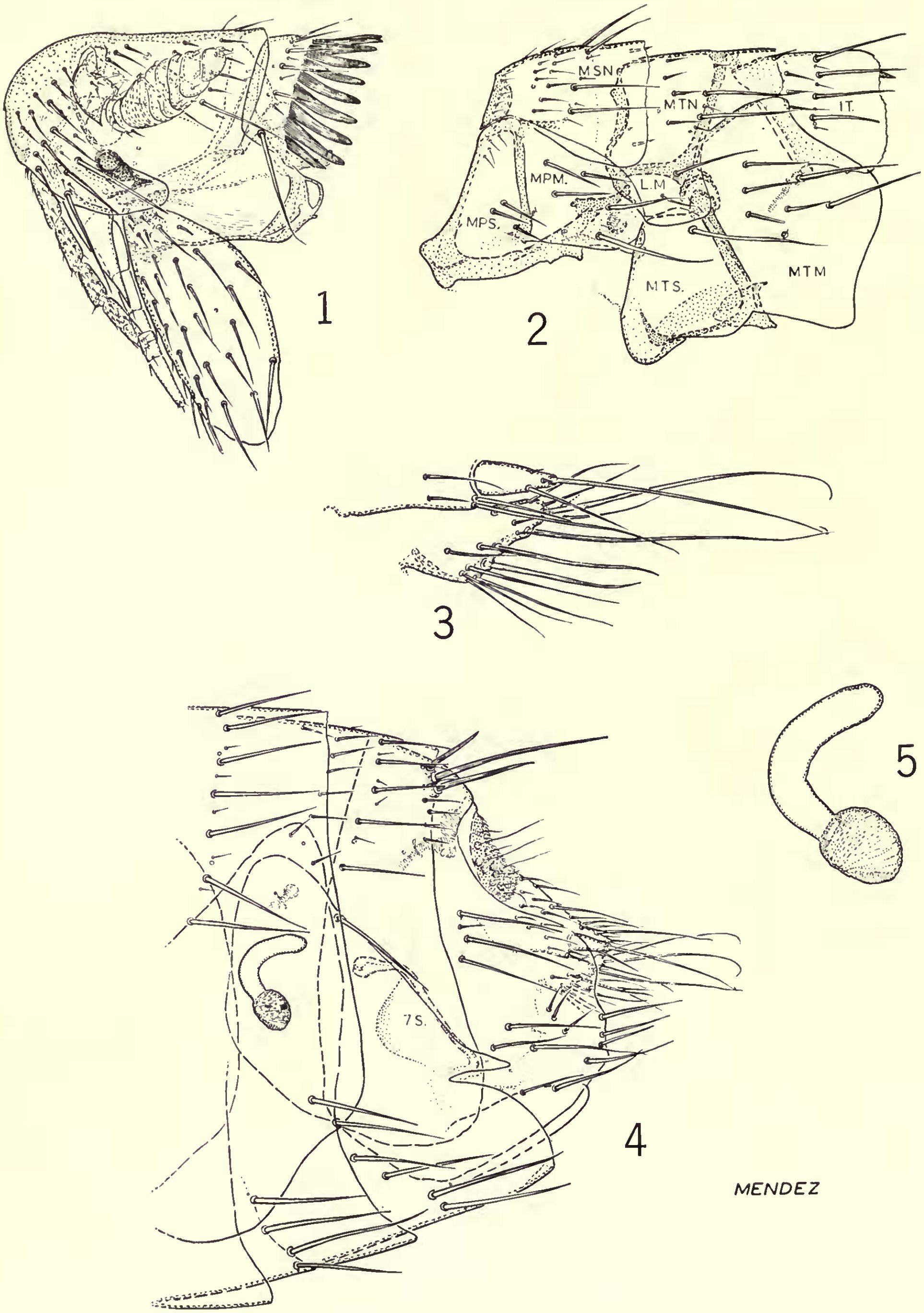
Pleochaetis altmani Tipton and Mendez. Female: 1, modified abdominal segments; 2, anal stylet and ventral anal lobe; 3, spermatheca. Male: 4, apex of aedeagus; 5, distal arm of ninth sternum.



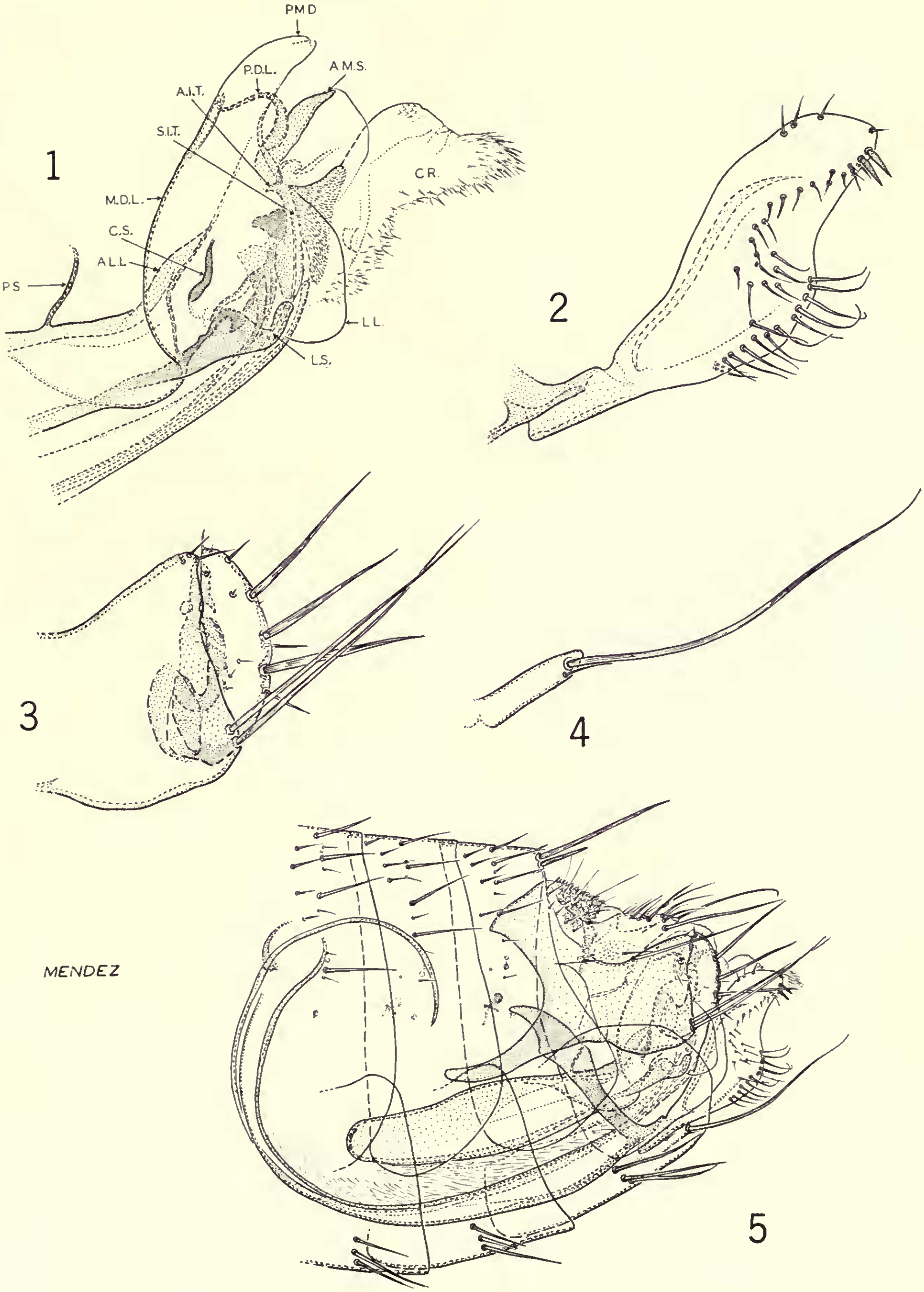
Pleochaetis dolens dolens (Jordan and Rothschild), male. 1, head, prothorax and procoxa. 2, process and movable finger of clasper. 3, eighth sternum. 4, modified abdominal segments.



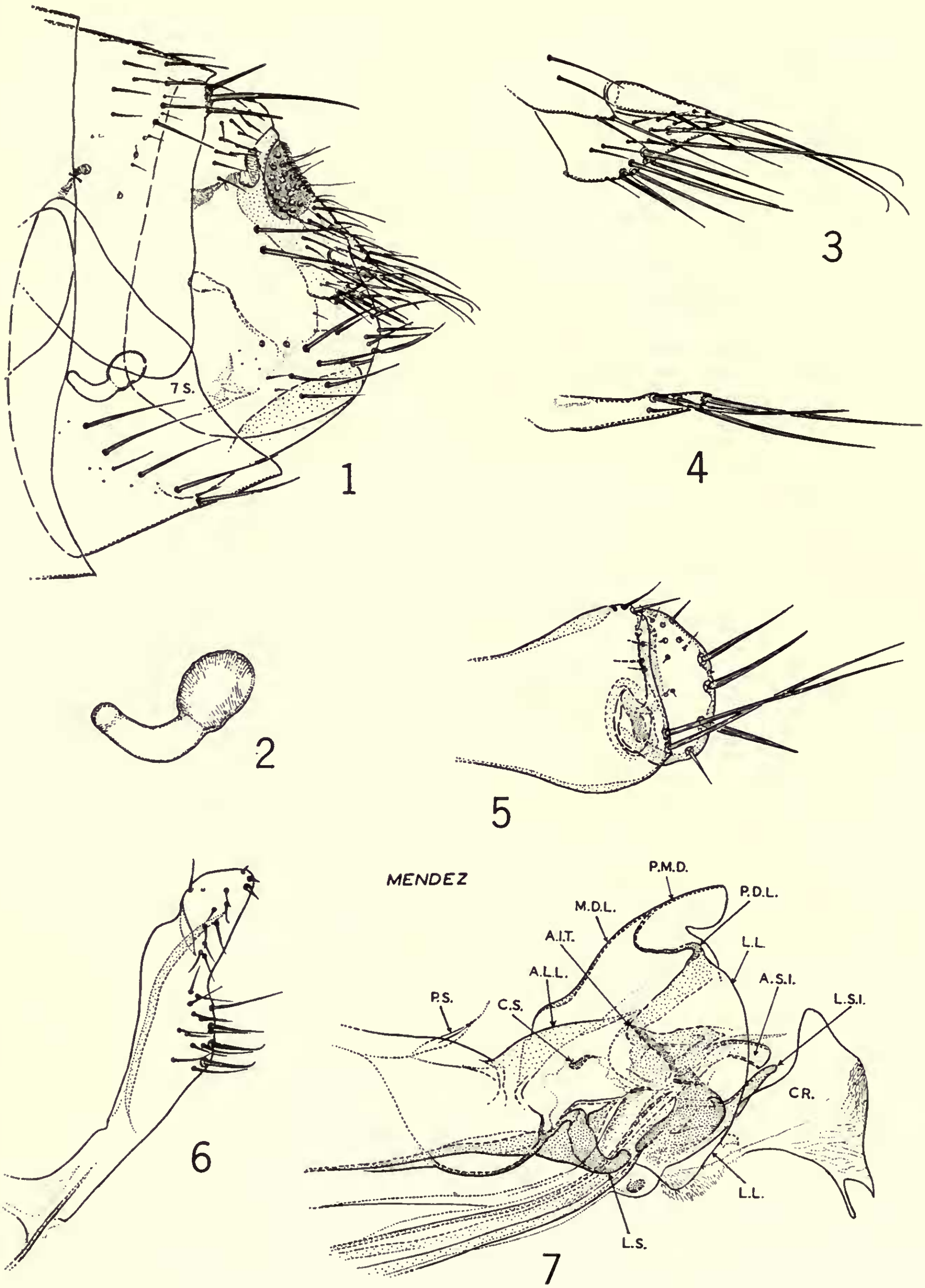
Pleochaetis dolens dolens (Jordan and Rothschild). 1, female, modified abdominal segments. 2, female, anal stylet and ventral anal lobe. 3, male, distal arm of ninth sternum. 4, male, apex of aedeagus. 5, female, spermatheca.



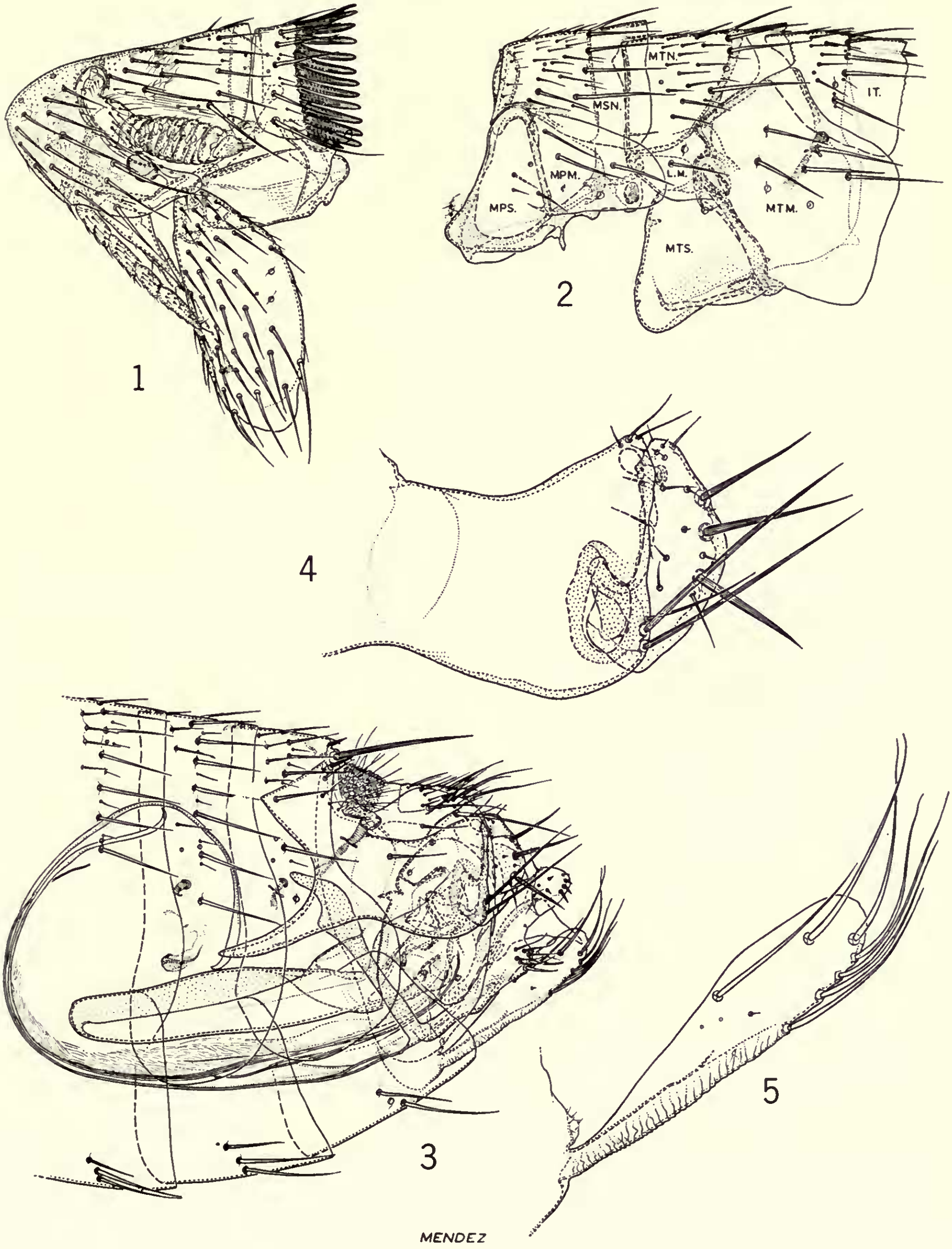
Kohlsia azuerensis, new species. Male: 1, head, prothorax and procoxa; 2, meso-metathorax and first abdominal tergum. Female: 3, anal stylet and ventral anal lobe; 4, modified abdominal segments: 5, spermatheca.



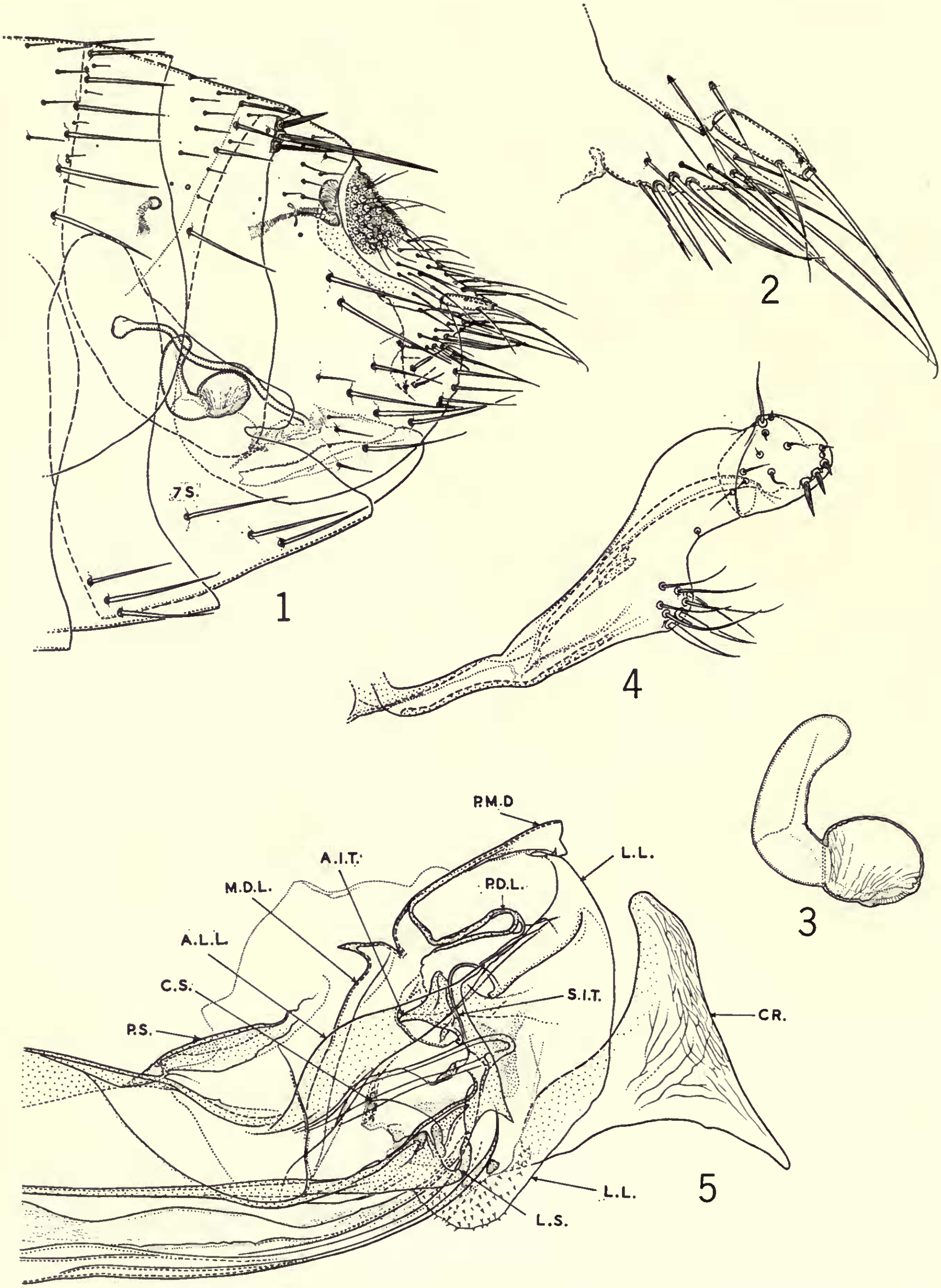
Kohlsia azuerensis, new species, male. 1, apex of aedeagus. 2, distal arm of ninth sternum. 3, process and movable finger of clasper. 4, eighth sternum. 5, modified abdominal segments.



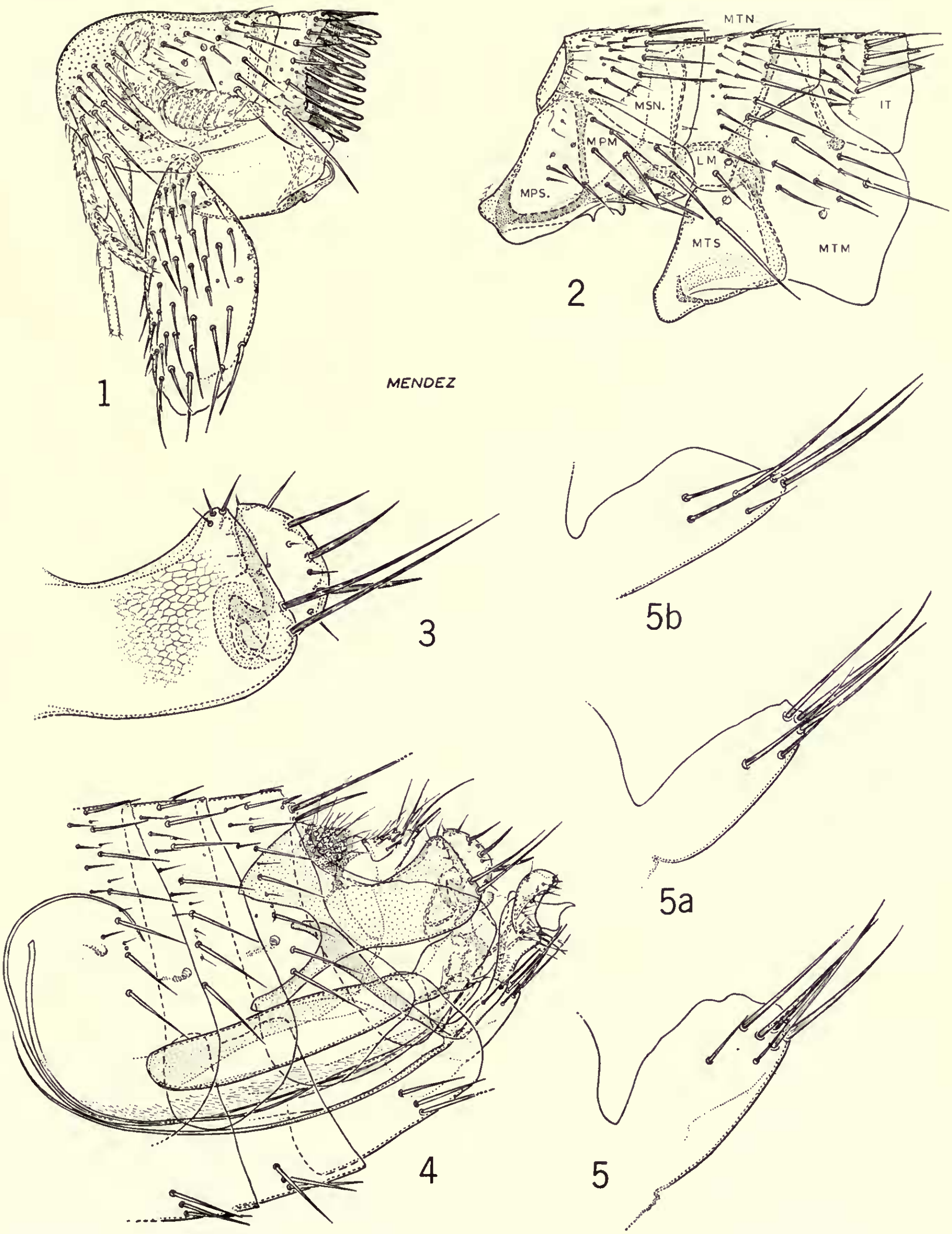
Kohlsia graphis graphis (Rothschild). Female: 1, modified abdominal segments; 2, spermatheca; 3, anal stylet and ventral anal lobe. Male: 4, eighth sternum; 5, process and movable finger of clasper; 6, distal arm of ninth sternum; 7, apex of aedeagus.



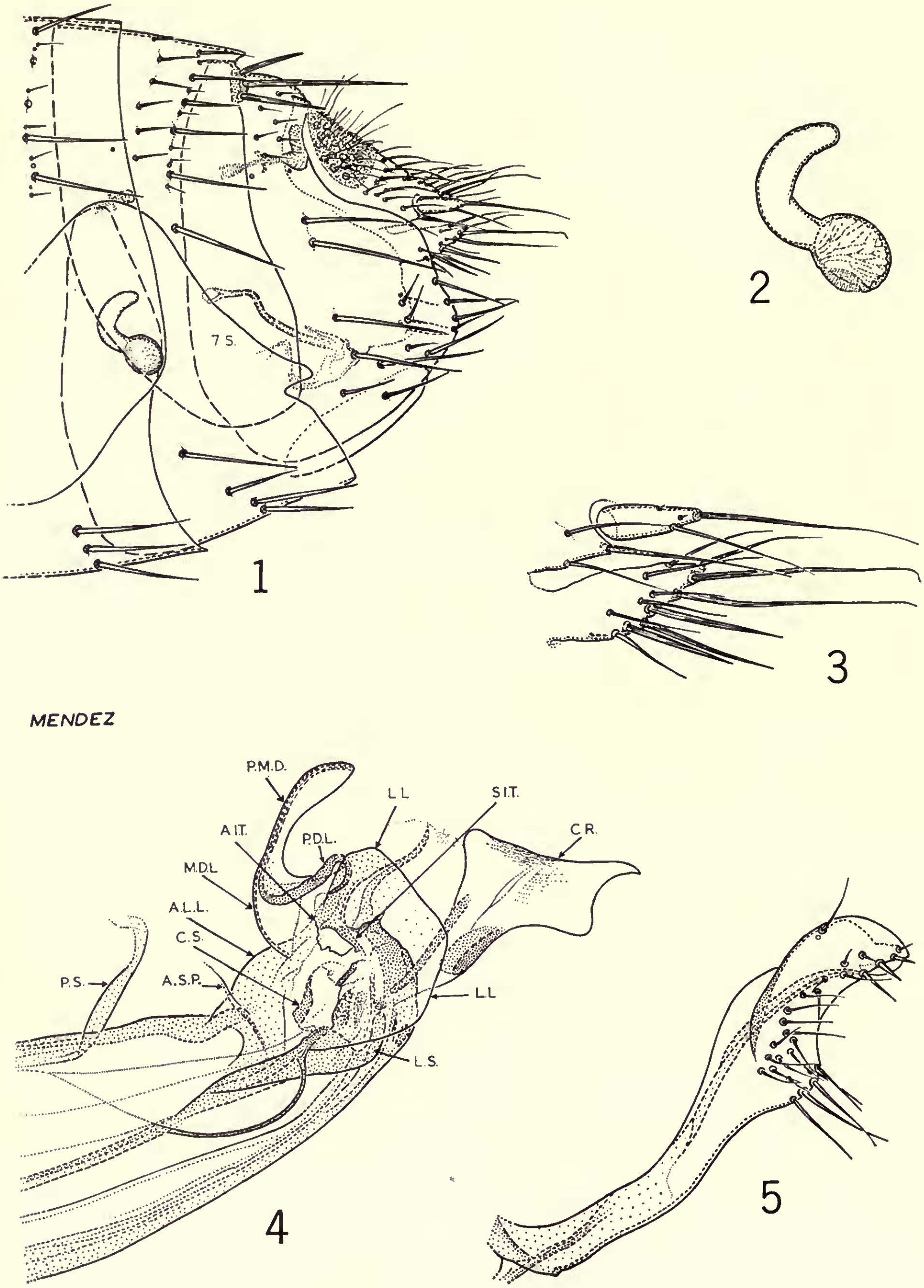
Kohlsia keenani Tipton and Mendez, male. 1, head, prothorax and procoxa. 2, meso and metathorax and first abdominal tergum. 3, modified abdominal segments. 4, process and movable finger of clasper. 5, eighth sternum.



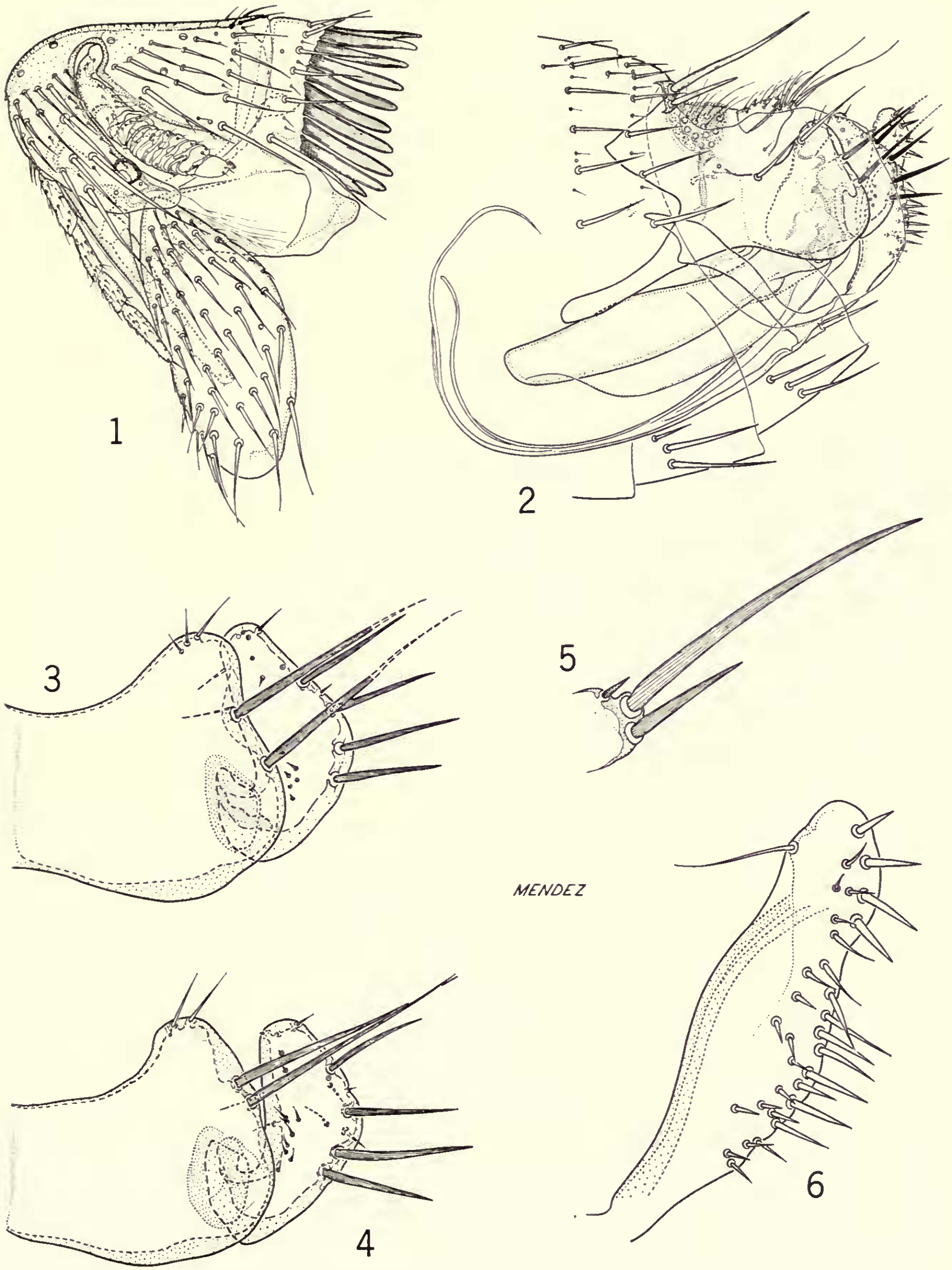
Kohlsia keenani Tipton and Mendez. Female: 1, modified abdominal segments; 2, anal stylet and ventral anal lobe; 3, spermatheca. Male: 4, distal arm of ninth sternum; 5, apex of aedeagus.



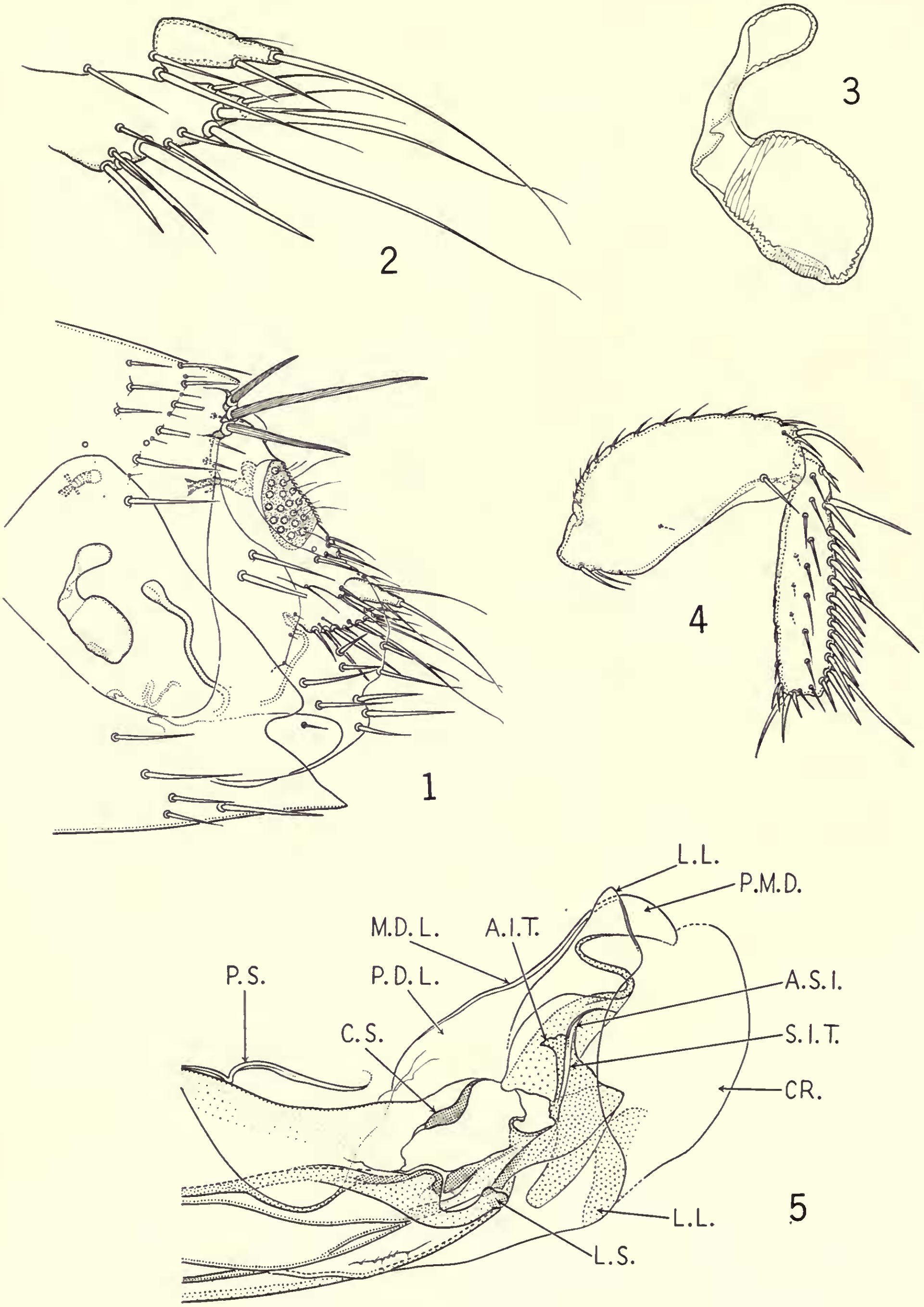
Kohlsia mojica, new species, male. 1, head, prothorax and procoxa. 2, meso- and metathorax and first abdominal tergum. 3, process and movable finger of clasper. 4, modified abdominal segments. 5, eighth sternum; a, b, variations.



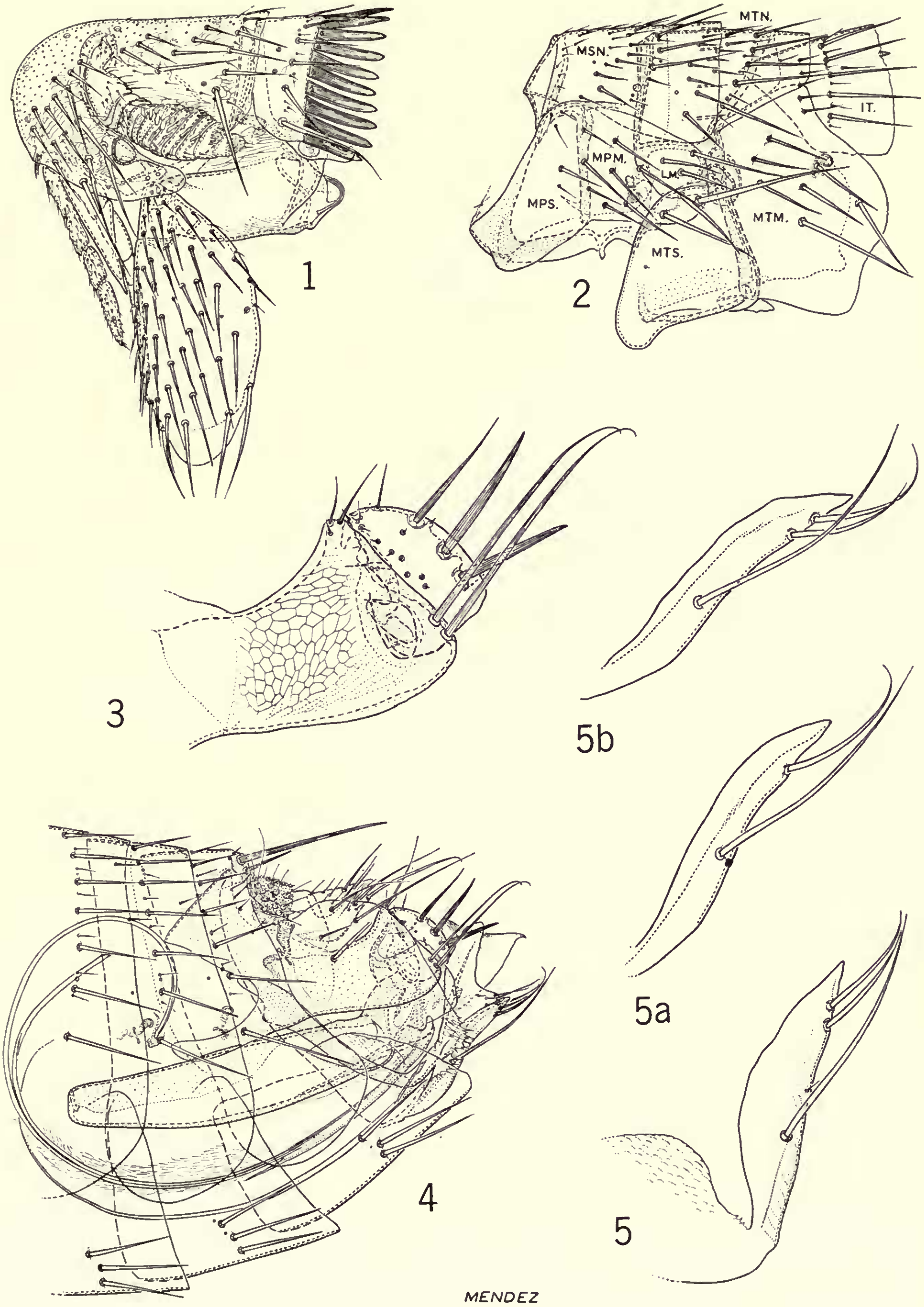
Kohlsia mojica, new species. Female: 1, modified abdominal segments; 2, spermatheca; 3, anal stylet and ventral anal lobe. Male: 4, apex of aedeagus; 5, distal arm of ninth sternum.



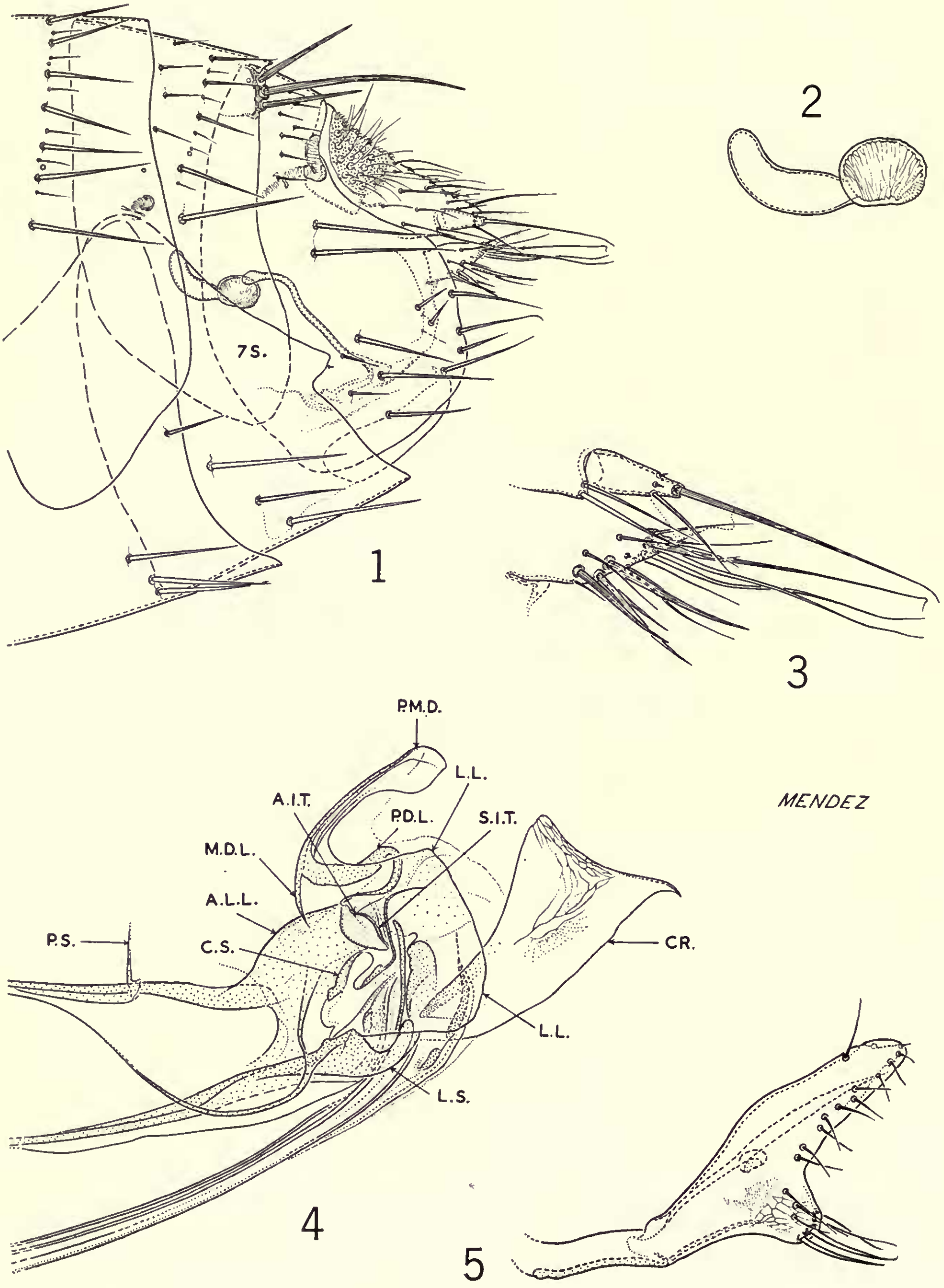
Kohlsia tiptoni, Mendez and Altman, male (figs. 1, 2, 3, 6, holotype male; 4, paratype male; after Mendez and Altman, 1960). 1, head, prothorax and procoxa. 2, modified abdominal segments. 3, 4, movable and immovable process of clasper of holotype and paratype, respectively. 5, antesensillial bristles. 6, distal arm of ninth sternum.



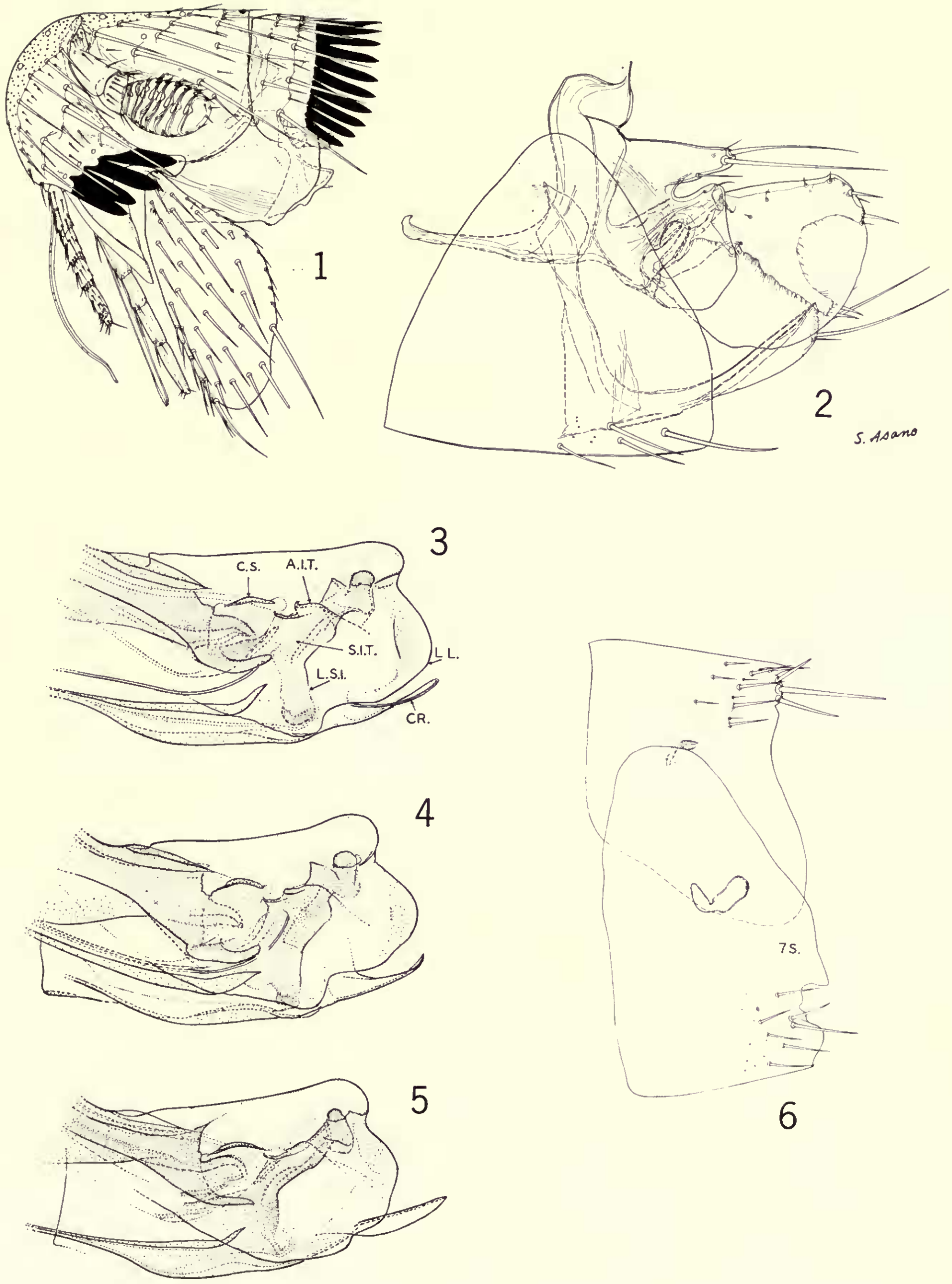
Kohlsia tiptoni Mendez and Altman (1–4, allotype female; 5, holotype male). Female: 1, modified abdominal segments; 2, anal stylet and ventral anal lobe; 3, spermatheca; 4, femur and tibia of hind leg. Male: 5, endchamber of aedeagus. After Mendez and Altman, 1960.



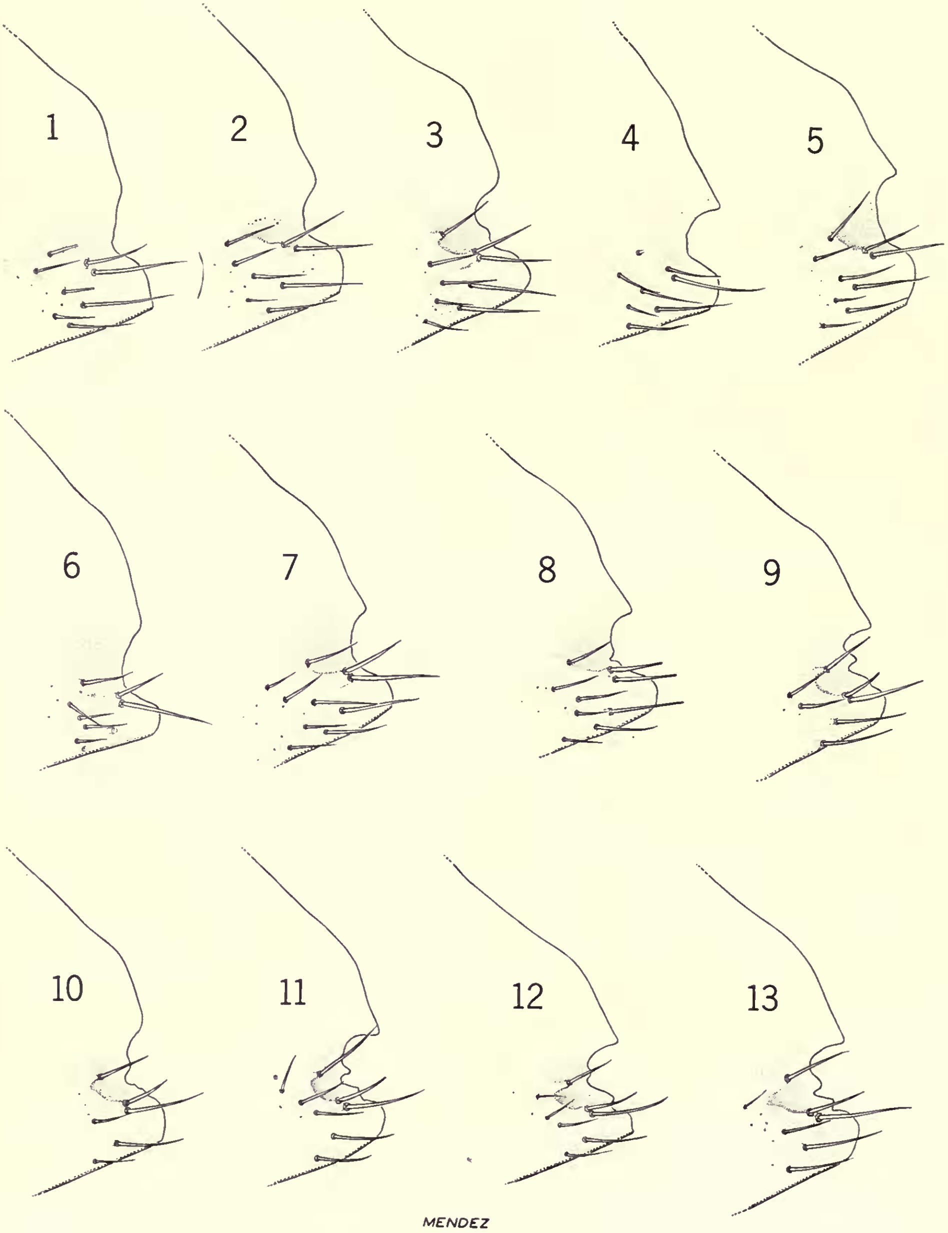
Kohlsia traubi Tipton and Mendez, male. 1, head, prothorax, and procoxa. 2, meso- and metathorax and first abdominal tergum. 3, process and movable finger of clasper. 4, modified abdominal segments. 5, eighth sternum; a, b, variations of eighth sternum.



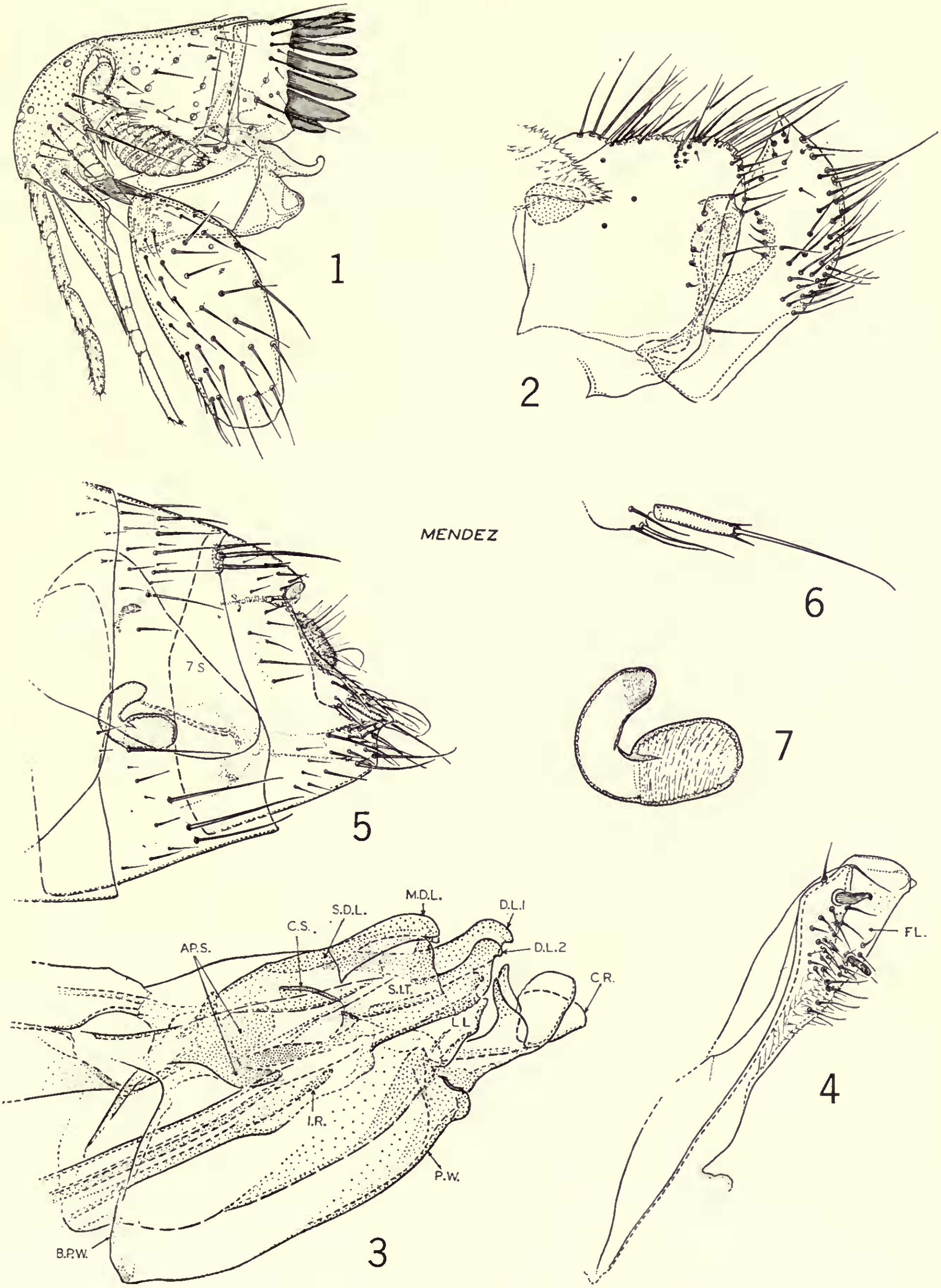
Kohlsia traubi Tipton and Mendez. Female: 1, modified abdominal segments; 2, spermatheca; 3, anal stylet and ventral anal lobe. Male: 4, apex of aedeagus; 5, distal arm of ninth sternum.



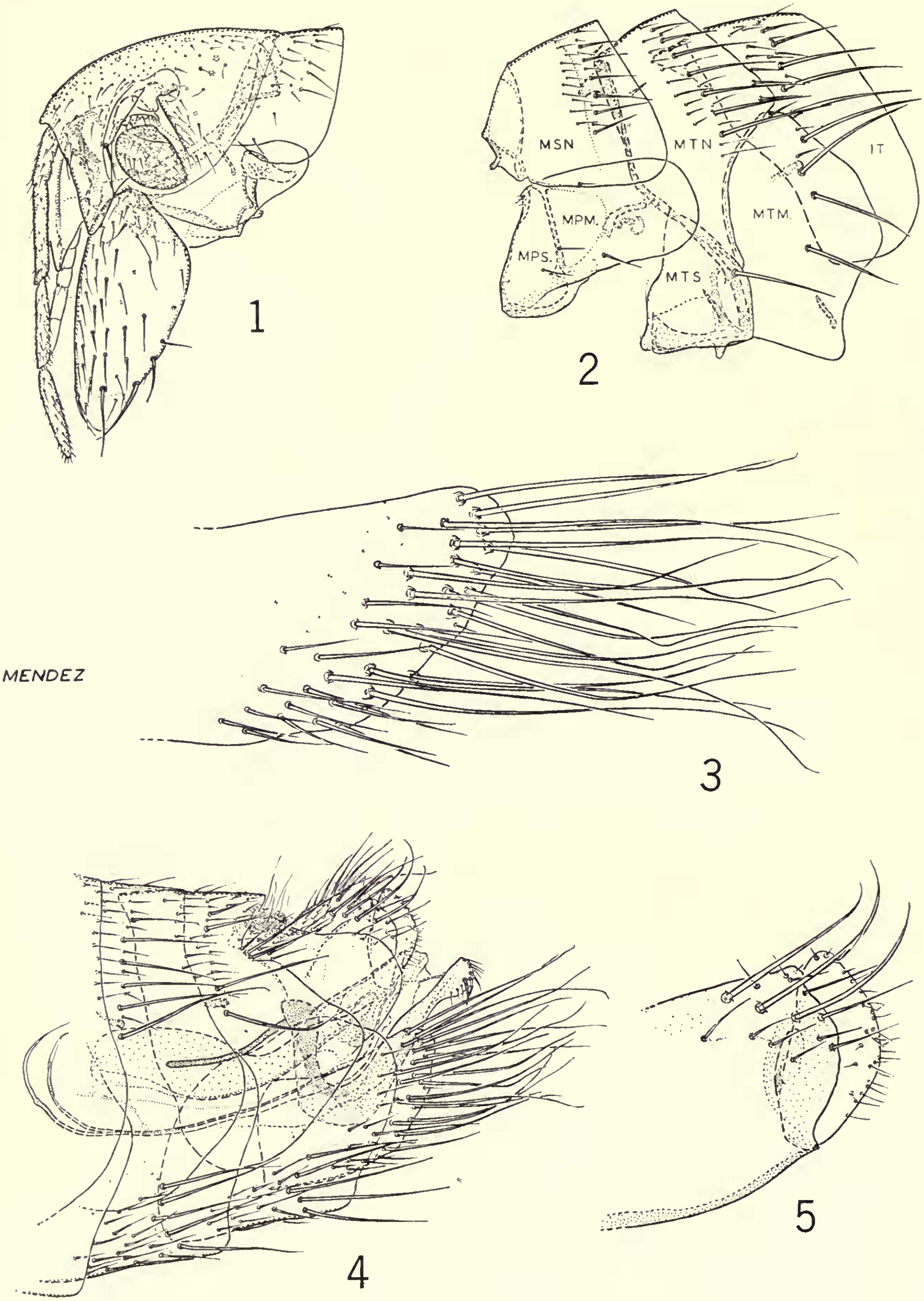
Adoratopsylla intermedia copha (Jordan). Male: 1, head, prothorax and procoxa; 2, genitalia; 3, apex of aedeagus, specimen from Cerro Punta (Chiriquí); 4, apex of aedeagus, specimen from El Valle (Coclé); 5, apex of aedeagus, specimen from Cerro Jefe (Panamá). Female: 6, spermatheca and seventh abdominal segment.



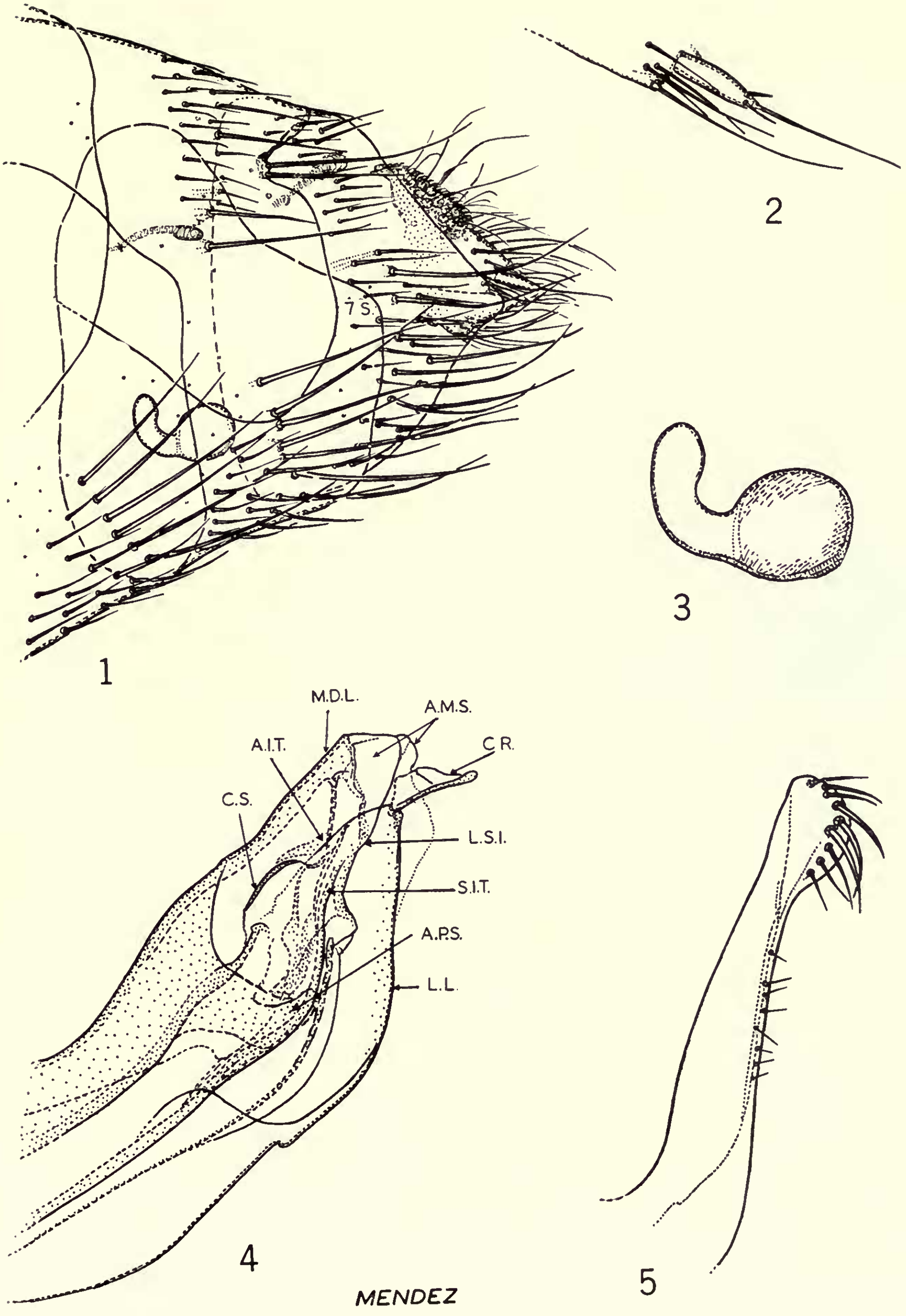
Adoratopsylla intermedia copha (Jordan). Female: Variations of seventh sternum. 1–5, specimens from Cerro Punta (Chiriquí). 6–9, specimens from El Valle (Coclé). 10–13, specimens from Cerro Azul (Panamá).



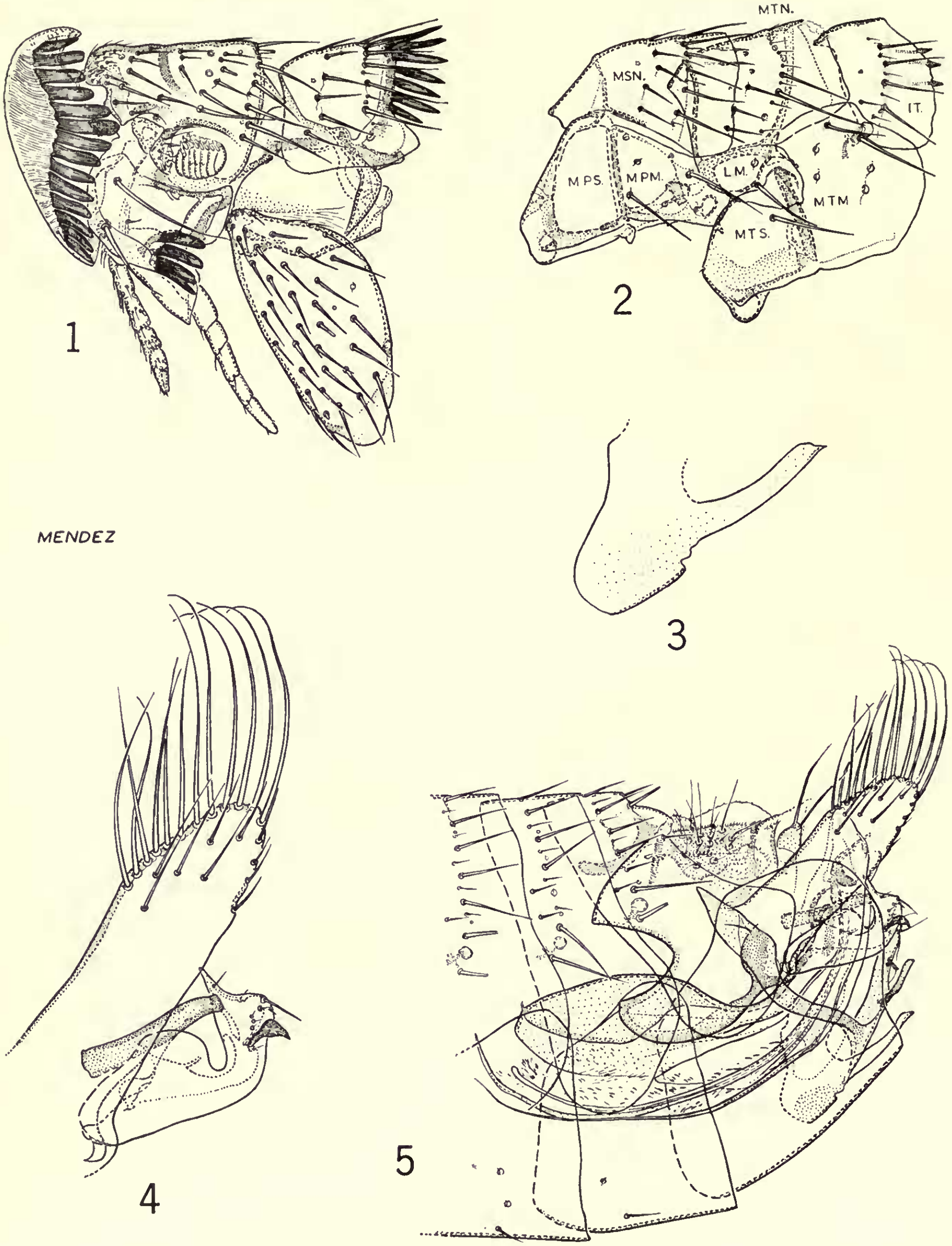
Strepsylla dalmati Traub and Barrera. Male: 1, head, prothorax and procoxa; 2, process and movable finger of clasper; 3, apex of aedeagus; 4, distal arm of ninth sternum. Female: 5, modified abdominal segments; 6, anal stylet; 7, spermatheca.



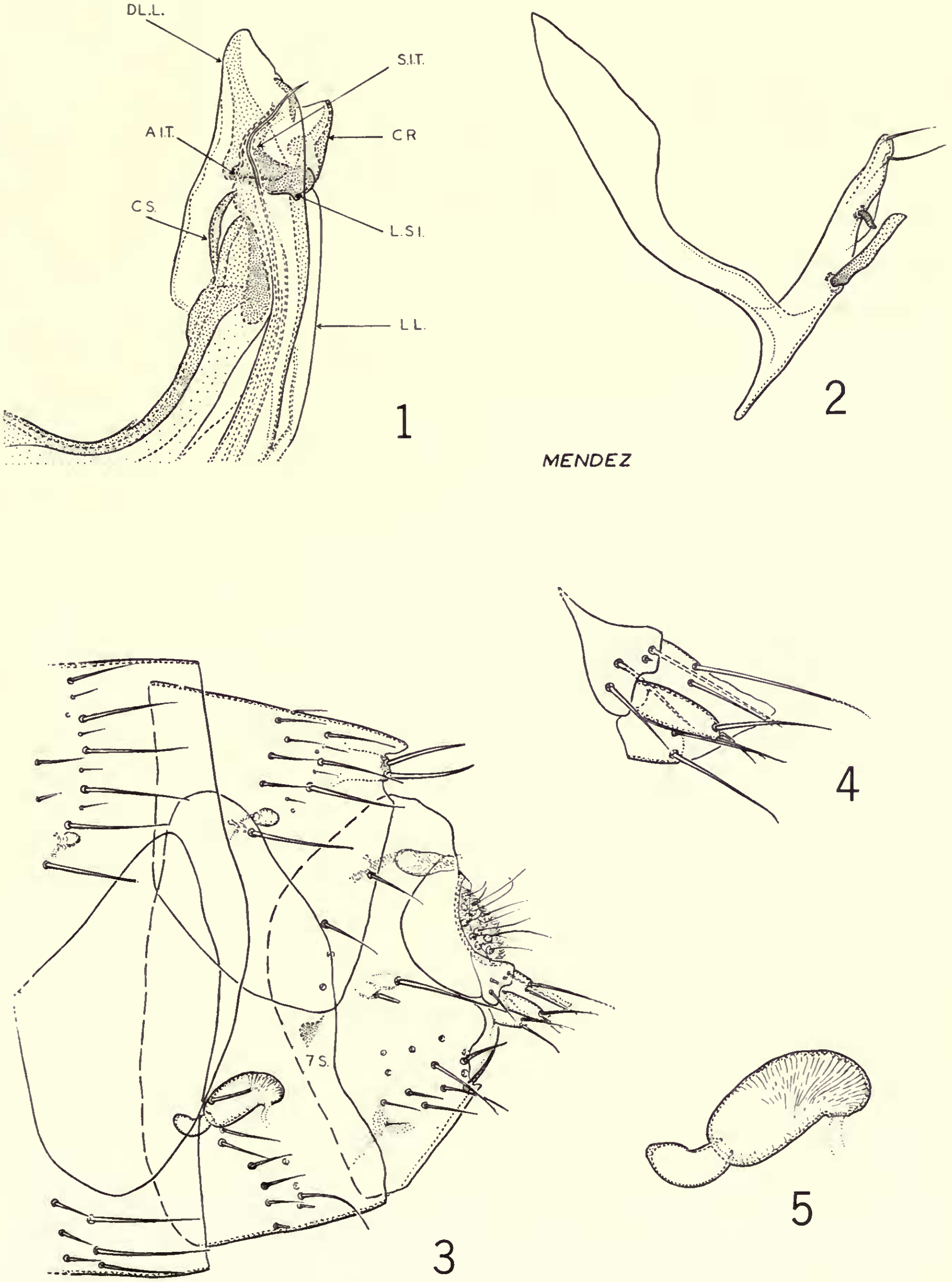
Wenzella yunkeri, new species, male. 1, head, prothorax and procoxa. 2, meso- and metathorax and first abdominal tergum. 3, eighth sternum. 4, modified abdominal segments. 5, process and movable finger of clasper.



Wenzella yunkeri, new species. Female: 1, modified abdominal segments; 2, anal stylet and ventral anal lobe; 3, spermatheca. Male: 4, apex of aedeagus; 5, distal arm of ninth sternum.



Plocopsylla scotinomi, new species, male. 1, head, prothorax and procoxa. 2, meso- and metathorax and first abdominal tergum. 3, eighth sternum. 4, process and movable finger of clasper. 5, modified abdominal segments.



Plocopsylla scotinomi, new species. Male: 1, apex of aedeagus; 2, ninth sternum. Female: 3, modified abdominal segments; 4, anal stylet and ventral anal lobe; 5, spermatheca.